Volume 22, Number 13, July 15, 1968

NUCLEAR SCIENCE ABSTRACTS

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Index References

All index entries refer the reader to volume and abstract number:

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FOURRIER, Alain
  Radioactive chain of mass number 189,  21:10023
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Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

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MONTH, M.
  Theory of gradient perturbations in AGS,  21:9872 (BNL-
    10899)
MONTH, Melvin
  Simple relativistic calculation of the electromagnetic
    form factors of the deuteron,  21:9744
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Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

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SHEEP
  radiation dosimetry in, measurement of lethal dose of x,
    21:8905(R) (AD-631189)
  radiosensitivity of hematopoietic system of, x,
    21:8905(R) (AD-631189)
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    21:8779(R) (AD-629928)
  equipment for fallout, minimal requirements of,
    21:8782(R) (AD-631424)
  evaluation of fallout, for fire and air blast damage,
    21:8560 (URS-658-3)
  fire resistance of components of, evaluation of,
    21:8789(R) (AD-642241)
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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

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UNION CARBIDE CORP., OAK RIDGE, TENN.  Y-12 PLANT.
  Mixing and sampling enriched 235U fluids in cylindrical
    storage containers,  21:8500 (Y-1561)
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Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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TID-
  3311(Suppl.  21-8567   Dep. mn. CFSTI $3.00 cy, $0.65 mn
    2)
  22298        21-9915   Nucl. News, 9: No. 12, 17-21 (Dec.
                           1966)
  22298        21-9914   Nucl. News, 10: No. 1, 17-20(Jan.
                           1967)
  23267        21-9702   Phys. Rev., 152: 1171-82(Dec. 23,
                           1966)
  23287        21-8498   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23420        21-8764   Lancet, 2: 672-5(Sept. 24, 1966)
  23474        21-8528   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23478        21-8641   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23482        21-9471   Dep. mn. CFSTI $3.00 cy, $0.65 mn
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CHEMISTRY

Analytical Chemistry

Refer also to abstracts 25324, 25440, 25455, 25665, 25683, 26763, 26932, 27396, and 27477.

25233 (AERE-R-5431) DATA PROCESSING FOR DIGITALLY RECORDED MASS SPECTRA. Cuthbert, J.; Silk, C. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1968. 34p. Dep. CFSTI. UK.

A digital voltmeter can be used to sample and record the output from a mass spectrometer several times a second. Computer programs are described which locate the peaks in such a digital spectrum, calculate their masses, compare these with the masses expected to be present in the spectrum, and detect and record extra peaks due to contaminants. The programs calculate peak heights, and, in the examples tested so far, compute isotopic analysis results. A computer drawn visual display of the spectrum can also be provided. (auth)

25234 (AERE-R-5756) ELECTRON PROBE MICRO ANALYSIS OF THIN OXIDE FILMS. Bennett, M. J.; Shaw, J. L.; Chaffey, G. H. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 7p. Dep. CFSTI. UK.

A technique is described for the electron probe analysis of thinner oxide films (< 4μm thick) than was possible previously. The method involves examination of chemically stripped films. The procedure was used to determine the composition of oxide films formed during the oxidation of austenitic stainless steels at high temperatures, including the highly irradiated corrosion products of in-reactor oxidation. (auth)

25235 (CEA-N-616) RAPPORT SEMESTRIEL DU DEPARTEMENT DE CHIMIE, NOVEMBRE 1965–MAI 1966. (Semiannual Report of the Chemistry Department, November 1965–May 1966). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1966. 457p. (In French). Dep.

Twelve sections are included; separate abstracts were prepared for 11. One section is a summary of technological activities. (P.C.H.)

For abstracts of individual sections see: 25236, 25323, 25449–25456, and 26026.

25236 (CEA-N-616, pp 20-71) ANALYSE CHIMIQUE. (Chemical Analyses). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: analyses for Pu; preparation of solutions of irradiated or reconstituted fuels of U and Pu with a view to analysis; execution and development of electrochemical analyses; chemical analyses by other methods; optical emission, atomic absorption, and fluorescence spectrometry; determination of gases in metals; determinations in solution; analysis of Be; analysis of active products; studies, realizations, and maintenance of apparatus of analysis; control of nuclear materials; analysis of nuclear fuels; and analyses in relation with the workroom for treatment of enriched U and current analyses. (P.C.H.)

25237 (IS–1811) RESOLF: A COMPUTER PROGRAM FOR THE ANALYSIS OF GAMMA-RAY SPECTRA. Korthoven, P. J. M. (Ames Lab., Iowa). Apr. 1968. Contract W-7405-eng-82. 63p. Dep. CFSTI.

RESOLF, a computer program for the analysis of gamma spectra, is presented. It is based on a linear least squares procedure although spectrum stripping options are incorporated for identification of unknown components in the spectrum. A component need not be a single isotope, but may be a mixture of several, so long as the spectrum is a linear combination of the component spectra. For the analysis, spectra of all components must be available. A direct search method is included for optionally shifting the component spectra until the best possible fit is obtained. A large number of options are included in the program to make it a flexible tool for activation analysis purposes. For a large number of variables, standard options are built into the program, which makes it easier for inexperienced users to obtain good results with the program. A number of applications of the program are discussed. (auth)

25238 (IS-T-223) ION EXCHANGE SEPARATION AND FLAME EMISSION SPECTROMETRIC DETERMINATION OF TRACE IMPURITIES IN RARE EARTH METALS AND COMPOUNDS. Wolcott III, James Franklin (Ames Lab., Iowa). Feb. 1968. Contract W-7405-eng-82. 40p. Dep. CFSTI. Thesis.

A simple quantitative method for the determination of trace amounts of Al, Ca, Cr, Cu, Fe, Mg, and Ni in rare earth compounds was developed. A strongly basic anion exchanger and 90% methanol–10% 3M HNO_3 eluant are used to separate impurities from the rare earth matrix. Determination of the impurities is effected using a nitrous oxide–acetylene slot burner and flame emission spectrometric techniques. Average precision is ±2.4% at the 300 ppM level. (auth)

25239 (ISO-SA-11) DETERMINATION OF ^{241}Am IN RARE EARTH CONCENTRATES BY SOLVENT EXTRACTION. Johnson, W. C. Jr. (Isochem Inc., Richland, Wash.). June 30, 1966. Contract AT(45-1)-1851. 12p. (CONF-660907-13). Dep. CFSTI.

From 152nd National Meeting of the American Chemical Society, New York.

A radiochemical procedure for the separation and determination of ^{241}Am in rare earth concentrate solutions is described. The rare earths, yttrium, and americium are preferentially extracted into 1.5M di-(2-ethylhexyl) orthophosphoric acid in toluene from a nitric acid solution adjusted to a pH of 1.1 to 2.0. On stripping the rare earths and americium into 1.0M nitric acid, an acid adjustment is made and the cerium is removed by extraction into 0.5M TTA in xylene after oxidation to the (4^+) valence state with sodium dichromate. The americium is reextracted into 1.5M di(2-ethylhexyl) orthophosphoric acid in toluene; stripped into 3.0M nitric acid, mounted, counted for total alpha content, and the alpha energy analyzed. Americium distribution ratios are presented as a function of pH and the effect of beta and gamma radiation on the alpha energy analysis is discussed. Recoveries of 90% were obtained by four different analysts with a standard deviation of ±1.2%. (auth)

25240 (PG-Report-827) PRECISE AMPEROMETRIC TITRATION FOR THE DETERMINATION OF URANIUM USING FERROUS SULPHATE AS REDUCTANT. Cherry, J. (United Kingdom Atomic Energy Authority, Sellafield (England). Production Group). 1968. 16p. Dep. CFSTI. UK 2s. 0d.

The titrimetric method of Davies and Gray (Talanta 1964, 11, 1203) for determination of uranium in nitric acid was modified by the introduction of amperometric end-point detection, with a consequent improvement in precision and sensitivity. The use of sulfuric acid solution as diluent instead of water enables the

method to be used for the determination of uranium in plutonium solutions. (auth)

25241 (RFP-665) DIFFERENTIAL COLORIMETRY FOR NUCLEAR PROCESS STREAMS. Martinez, J. L.; Hart, G. E. (Dow Chemical Co., Denver, Colo. Rocky Flats Div.). [1966]. Contract AT(29-1)-1106. 10p. (CONF-660933-1). Dep. CFSTI.

From 10th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

An in-line process differential colorimeter, with automatic check system, was developed with the capability of determining Pu(IV) in the range from 0.1 to 2.5 g/l. The instrument measures the difference in light transmittance at two wavelengths, 580 and 660 nanometers. These wavelengths are a characteristic of Pu(IV), and the difference in transmittance is a measure of the plutonium concentration. (auth)

25242 (TRG-Report-1059) DETERMINATION OF THE SPECIFIC ACTIVITY OF ^{14}C LABELLED CARBON: A CRITIQUE. Sheppard, M. F. (United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Group). Apr. 21, 1966. 9p. (JNPC-MWP(GSG)/P-(66)43). Dep. CFSTI. UK.

Existing procedures for determination of specific activity are reviewed in the light of current ideas on mechanisms of graphite attack. Some experimental evidence is now becoming available to show that theoretical defects in the procedures can in fact lead to incorrect answers. The importance of thorough checks on the homogeneity of labeling of samples is emphasized, and the immediate program of experimental work is outlined. (auth)

25243 (UJV-1916) VOZMOZHNOSTI OPREDELENIYA SODERZHANIYA IZOTOPNOGO NOSITELYA I NEIZOTOPNYKH PRIMESEI V RADIOAKTIVNYKH PREPARATAKH S VYSOKOI UDEL'NOI AKTIVNOST'YU. (Determination Possibilities of Isotopic Carrier and Non-Isotopic Impurity Amounts in High Specific Radioactive Preparations). Mudrova, B.; Knoblokh, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Dec. 1967. 27p. (In Russian).

Carrier-free radioactive preparations are considered. The commercially available carrier-free preparations, their nuclear characteristics, and their production methods are given in tabular form. Application possibilities of most common trace analytical methods for the semiquantitative and quantitative determinations of carrier and other nonisotopic impurities in high-specific-activity radioactive preparations are discussed. (auth)

25244 (KFK-tr-247) MITFAELLUNG VON U(VI) MIT EISEN(III)-HYDROXID. (Coprecipitation of U(VI) with Iron(III)-Hydroxide). Ishibashi, M.; Fujinaga, T.; Kuwamoto, T.; Ogino, Y. Translated into German by Peter Buriks (Kernforschungszentrum, Karlsruhe, Ger.), from Nippon Kagaku Zasshi, 88: 73-6 (1967). 13p. (In German). Dep. JCL $1.60 fs, $0.80 mf.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 12357. (P.C.H.)

25245 DETERMINATION OF STRONTIUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Tanaka, Giichiro. (National Inst. Radiological Sciences, Chiba, Japan); Tomikawa, Akeo. Nippon Kagaku Zasshi, 89: 175-85(Feb. 1968). (In Japanese).

The method for determining Sr was studied by use of a double-beam atomic absorption spectrophotometer. The spectral line employed was Sr 4607 Å and optimum conditions for lamp currents, gas pressures, and slit widths were examined. The analytical curve for Sr showed good linearity up to 20 ppM. "Sr-free" calcium salt was prepared by fuming nitric acid treatment, and the calcium salt did not affect the linearity of the analytical curve but only changed the slope. Effects of inorganic acids, organic acids, CN^-, SCN^-, and EDTA on the absorbance of Sr were investigated. NH_4OH should be avoided in neutralizing acids except HNO_3. The effects of 21 metal ions on the absorbance of Sr was examined for a wide concentration of Sr. In the presence of PO_4^{3-}, both Mg^{2+} and Ca^{2+}, especially Mg^{2+}, depressed the absorbance. SiO_3^{2-} and Al^{3+} also depressed the absorbance; and the addition of large amount of Ca^{2+} (15 times of Si and 25 times of Al, or more) eliminated these effects, while Mg^{2+} gave no such effect. Analytical procedures were studied for the samples from plants, animal tissues, bones, foods, and water. Coprecipitation and ion-exchanging methods were employed. A large number of samples were analyzed, the errors being within 4%. (NSA of Japan)

25246 COLORIMETRIC DETERMINATION OF NICKEL WITH 6-(THIAZOLYLAZO)-3-DIMETHYLAMINOPHENOL (TAM). Kasiura, Krzysztof; Sytniewska, Zofia (Politechnika, Warsaw). Chem. Anal. (Warsaw), 13: 177-83(1968). (In Polish).

It was found by spectrophotometric titration that nickel cations form a 1:2 complex with TAM that is readily extracted by chloroform. The instability constant of the complex (calculated on this basis) is 2.3×10^{-13}. Molar absorptivity at $\lambda_{max} = 520$ nm is $\epsilon = 75900$, and that at $\lambda = 575$ nm, where the reagent shows practically no absorption, amounts of $\epsilon = 46300$. The effect of salt concentration as well as the effect of some anions and cations on the formation of the complex was examined. The necessity of preliminary isolation of nickel from sample solution was established. A method for the determination of nickel in metallic indium was elaborated. (auth)

25247 PAPER THICKNESS AS FACTOR IN AUTORADIOGRAPHY OF ^{14}C. Tomisek, Arthur J.; Johnson, Betsy T. (Southern Research Inst., Birmingham, Ala.). J. Chromatogr., 33: 329-31(Mar. 12, 1968).

The effects of paper thickness on the quantitative analysis of ^{14}C-containing materials were examined. It was concluded from other reports that little or no loss of sensitivity results when thicker papers are used for chromatograms examined by techniques such as x-ray film exposure or ultraviolet light fluorescence. One valid explanation for this is the ability to obtain more compact chromatographic spots on thicker papers. However, the study shows that part of the explanation lies in the tendency of chromatographed materials to migrate to the surfaces of the paper as the papers dry. (auth)

25248 RESONANCE NEUTRONS IN THE ACTIVATION ANALYSIS OF GOLD. Prouza, Z.; Rakovic, M. (Veterinary Research Centre, Prague. Karlova Univ., Prague). Chem. Zvesti, 22: 87-92(1968).

An activation method for the determination of Au is described in which thermal neutrons are eliminated. In the analysis of biological materials, the application of resonance neutrons results in selective activation, which in combination with integral measurements and decomposition of the decay curve makes the method applicable to the determination of Au in biological samples at a concentration limit of 0.05 ppM. This method is also applicable to the determination of Au in CdTe. Activation is carried out in a Cd foil, followed by a 3-step chemical precipitation with an integral measurement of the γ activity using a scintillation counter. (B.L.M.)

25249 APPLICATION OF AN AIR-OPERATED DEVICE FOR IRRADIATION OF SAMPLES IN A REACTOR FOR ACTIVATION ANALYSIS. Shimkova, M.; Slunechko, Ya. (Inst. for Nuclear Research, Rez, Czechoslovakia). Chem. Zvesti, 22: 130-6(1968). (In Russian).

A simple pneumatic device for short-lasting irradiations of samples placed in a reactor is briefly described. The pneumatic rabbit with the samples to be studied moves with the velocity of 7 m/sec in the transport tube and a time of 5 sec for the transport of the moving rabbit from the irradiating place into the laboratory is necessary. A few examples of the practical use of the device described for the activation analysis, e.g., the determination of Hf in ZrO_2 samples; Ag in $(NH_4)_2SO_4$; Co in biological material and Al, respectively, are given. (auth)

25250 AUTOMATIC DETERMINATION OF SEVERAL TRACE ELEMENTS IN BIOLOGICAL MEDIA BY RADIOACTIVATION ANALYSIS: APPLICATIONS TO SEVERAL PHYSIOPATHOLOGIC PROBLEMS. Comar, D.; Le Poec, C.; Kellershohn, C. (CEA, Orsay, France). Strahlentherapie, Sonderbaende, 65: 350-64 (1967). (In French).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

An automatic apparatus was used for the routine determination of various elements by neutron activation analysis. After irradiation, liquid biological samples were chemically treated with a view to optimal separation of the radioelement to be measured. Chemical treatment included selective separation on an ion exchange resin, extraction by solvent, and a distillation procedure. Radioactivity was measured by β counting. With this apparatus it was possible to measure one sample every five minutes. The apparatus described may be modified for the determination of various radioelements. Some examples are given relating to the concentration of iodine and bromine in serum and in different fractions of the serum that were separated either by electrophoresis or by ion-exchange methods, and in saliva, urine, and eluates from paper chromatography. Pathological and control subjects on a diet for metabolic balance studies were studied over a long period and the results mentioned were obtained during this study. (auth)

25251 BREMSSTRAHLUNG ACTIVATION ANALYSIS OF IODINE AND MERCURY. Burrows, B. A.; Mulvey, P. F.; Cooper, R. D.; Cardarelli, J. A. (University Hospital, Inc., Boston. Boston Veterans Administration Hospital. Boston Univ. Army Labs., Natick, Mass.). Strahlentherapie, Sonderbaende, 65: 365-71(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Bremsstrahlung activation analysis was employed to measure trace quantities of ^{127}I and ^{198}Hg in biological samples. A 22-MeV linear accelerator was used with an average current during 60 to 90 minutes of irradiation of 250 microamps. Each sample was placed directly behind a water-cooled tungsten convertor. The electrons from the linac beam were captured in the convertor and the resultant bremsstrahlung activated ^{127}I to ^{126}I and ^{198}Hg to ^{197}Hg. The presence of ^{126}I or ^{197}Hg was confirmed by spectral analysis and half-life measurements. The induced radioactivity was proportional to the amount of element present down to 1 μg I and 2.5 μg Hg. Counting efficiency for the 0.386-MeV γ rays of ^{126}I with net counts equal to background, was 66% with the detecting apparatus used. It would appear that bremsstrahlung activation analysis using a high energy electron beam is suitable for the measurement of iodine and mercury in trace amounts. (auth)

25252 DETERMINATION OF IODINE IN TOTAL SERUM AND IN SERUM ALBUMIN BY NEUTRON ACTIVATION ANALYSIS. Frischauf, H.; Altmann, H. (Reaktorzentrum, Seibersdorf, Austria). Strahlentherapie, Sonderbaende, 65: 372-6(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Neutron activation analysis of the iodine content of serum necessitates its chemical separation to yield quantitative results. The short half-life of ^{128}I (25 minutes), however, leaves little time for chemical separation. The method used consists of drying the serum on a filter paper cone and irradiating the sample in a trace element-free plastic container in a neutron flux of 2.5×10^{12} n/cm^2/sec in an Astra reactor. Immediately after irradiation the paper funnels are ashed with oxygen in a Schöniger flask after addition of carrier iodine. After extraction with benzene, radioactivity is directly measured by gamma spectroscopy after several washings with aqueous sodium chloride solution. The whole separation procedure takes fifteen minutes. (auth)

25253 IN VIVO ACTIVATION ANALYSIS OF IODINE IN THE THYROID GLAND: A PRELIMINARY STUDY. Boddy, K. (Scottish Research Reactor Centre, Glasgow). Strahlentherapie, Sonderbaende, 65: 377-83(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

In vivo activation analysis to determine the total stable iodine content of the thyroid gland in man was investigated. A collimated beam of neutrons from the UTR-100 kW reactor was used for the irradiation of a thyroid phantom containing various quantities of iodine, and of human and animal thyroids in vitro. Counting was executed in a shadow-shielded whole-body monitor. A sensitivity of about 1 mg of iodine was shown to be attainable. Methods to improve sensitivity and to decrease the radiation dose to the organ are discussed. (auth)

25254 ACTIVATION ANALYSIS AS A METHOD OF INVESTIGATION IN DENTISTRY. Harndt, E.; Koeppe, P.; Oeser, H. (Freie Univ., Berlin). Strahlentherapie, Sonderbaende, 65: 384-9 (1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The arsenic content of teeth that were devitalized for a considerable time was determined by neutron activation analysis. The short half-life of ^{76}As and the contamination of the samples with ^{24}Na and ^{32}P made it necessary to separate the arsenic with the help of paper chromatography and pulse-height analysis. In another series of experiments the diffusion of different contents of amalgam into teeth was examined by activation analysis. By analyzing a large number of fillings it was shown that the relative concentration of silver and mercury remains fairly constant up to 40 years, while tin diffuses to a large extent into the tooth. (auth)

25255 NEUTRON ACTIVATION ANALYSIS DETERMINATION OF RADIOSENSITIZERS. Altmann, H.; Frischauf, H.; Adamiker, D.; Kaindl, K. (Reaktorzentrum, Seibersdorf, Austria). Strahlentherapie, Sonderbaende, 65: 390-5(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Methods are described for isolating halogens from halogenated pyrimidines and mercury from hydroxymercuribenzoate in tissues after activation with thermal neutrons. It is impossible to measure chloropyrimidine concentrations accurately by these methods because of the high chloride content of the cells. Bromine is precipitated as AgBr with $AgNO_3$ (acid system) after distillation into NaOH following ashing of the tissue by van Slyke acid digestion. The ^{82}Br in the precipitate is then measured by γ spectrometry. Organic material containing iodine was ashed in oxygen in a Schöniger flask. After addition of carrier, iodine was converted to the inorganic state and radioactivity measured by γ counting. Since mercury compounds are volatile, the sample is kept in saturated ammonium sulfate and volatilized Hg is captured as HgS. Mercury is finally determined in acid solution by the method of Gorsuch. The use of inactive radiosensitizers and neutron activation analysis is preferable to the use of radioactive radiosensitizers since selfirradiation is avoided. (auth)

25256 ISOTOPIC DETERMINATION OF ^{18}O IN GASES BY NEUTRON TIME-OF-FLIGHT SPECTROMETRY. Peisach, Max; Pretorius, Rene; Strebel, Paul J. (Southern Universities Nuclear Inst., Faure, South Africa). Anal. Chem., 40: 850-3(May 1968).

Oxygen-18 was determined in gases by time-of-flight spectrometry of the prompt neutrons from the reaction $^{18}O(p,n)^{18}F$ produced by a pulsed beam of protons of 5.0 MeV. The analysis is nondestructive and, with a beam current of 0.5 to 1.5 μA requires from 5 to 30 minutes per sample. The method is applicable to isotopic concentrations from 0.204 atom % (natural level) to 100%. The relative standard deviation was $\pm$3.8% and the sensitivity, 7.2×10^{-3} g/cm^2. (auth)

25257 FAST SEPARATION OF Ti(IV), As(III), W(VI), Au(III) FROM NUMEROUS METAL IONS AND OF Fe–Al–Ti BY PAPER CHROMATOGRAPHY. Qureshi, Mohsin; Khan, Fahmida (Aligarh Muslim Univ., India). J. Chromatogr., 34: 222-36 (Apr. 9, 1968).

Ti^{4+} was successfully separated from its binary mixtures with 32 cations using formic acid–hydrochloric acid–acetone (3 : 5 : 2). The cations include Cu^{2+}, Al^{3+}, Fe^{3+}, V^{4+}, Mo^{6+}, W^{6+}, Zr^{4+}, Th^{4+}, Ni^{2+}, and Co^{2+}. Ti^{4+} stays at the point of application while other ions have R_F values greater than 0.5. The separation is successful in the presence of acetate, tartrate, formate and citrate. Au^{3+} and W^{6+} were separated from numerous metal ions using 70% nitric acid-n-butanol (6 : 4). W^{6+} stays at the point of application while Au^{3+} goes to the solvent front. As^{3+} was separated from its binary mixtures with 25 cations using pure formic acid as the eluent. The ions studied include Sb^{3+}, Cu^{2+}, and Sn^{2+}. The presence of common anions does not affect this separation. W^{6+} was separated from its binary mixtures with 35 ions. The ions include Mo^{6+}, Ti^{4+}, Th^{4+}, UO_2^{2+}, V^{4+}, Co^{2+}, Ni^{2+}, and Pd^{2+}. Separation of Fe^{3+}–Al^{3+}–Ti^{4+} was achieved using formic acid-hydrochloric acid-acetone (3 : 4 : 3). The separation is successful in the presence of common anions and no special method for the preparation of the sample is necessary. (auth)

25258 QUANTITATIVE SEPARATION OF TITANIUM FROM NUMEROUS METAL IONS AND OF IRON, ALUMINUM, AND TITANIUM BY PAPER CHROMATOGRAPHY. Qureshi, Mohsin; Rawat, Jagdish P.; Khan, Fahmida (Aligarh Muslim Univ., India). J. Chromatogr., 34: 237-40(Apr. 9, 1968).

Titanium was quantitatively separated from numerous metal ions using formic acid-hydrochloric acid-acetone (3 : 5 : 2). The method was found useful for the quantitative separation of about 200 μg of titanium from a synthetic mixture of 17 metal ions including Mo^{6+}, W^{6+}, Cu^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Ni^{2+}, Co^{2+}, Mn^{2+}, UO_2^{2+}, and V^{4+}. Quantitative separation of Fe^{3+}–Al^{3+}–Ti^{4+} was achieved using formic acid-hydrochloric acid-acetone (3 : 4 : 3). Both separations are fast and selective. (auth)

25259 INSTRUMENTAL ACTIVATION ANALYSIS OF STANDARD ROCKS WITH HIGH RESOLUTION γ-RAY DETECTORS. Gordon, Glen E.; Randle, Keith; Goles, Gordon G.; Corliss, John B.; Beeson, Marvin H.; Oxley, Susanna S. (Univ. of California, La Jolla, San Diego). Geochim. Cosmochim. Acta, 32: 369-96 (Apr. 1968).

Instrumental neutron activation analysis with high-resolution lithium-drifted germanium detectors was used to determine 23 elements in a wide variety of igneous rocks. Principal γ-rays used in the determinations and their major interferences are listed. Redetermined energies of γ-rays from ^{59}Fe are more accurate than those previously reported. Elements determined included almost all alkalies, many lanthanides and transition elements, and several strongly lithophilic trace elements which are useful as indices of geochemical differentiation. Data are reported for six U.S.G.S. standard rocks, a sub-alkaline abyssal basalt, and a rhyolite obsidian. Among the significant trends indicated by elemental ratios for these rocks are increases in K/Cs and Ba/Cs with differentiation, and Zr/Hf ratios in the whole rocks which are lower than those previously observed in zircon separates. Possible extensions and improvements of the technique, which can lead to the determination of at least 6 additional elements, are discussed. (auth) (UK)

25260 SILICON ABUNDANCES IN SOME METEORITES AND STANDARD ROCKS BY ACTIVATION ANALYSIS. Ehmann, William D.; Durbin, Daniel R. (Univ. of Kentucky, Lexington). Geochim. Cosmochim. Acta, 32: 461-4(Apr. 1968).

Analytical data for silicon in 18 meteorites and 8 standard rocks were obtained by fast neutron activation analysis. The meteorite data, together with the data of Vogt and Ehmann (1965) were used to compute mean silicon abundances among the chondrite classes of Van Schmus and Wood (1967). (auth) (UK)

25261 RAPID AND SIMPLE CONTINUOUS RADIOCHEMICAL SEPARATION OF COPPER, MAGNESIUM, ZINC, AND MANGANESE IN BIOLOGICAL MATERIALS. Hahn, Kwang J.; Tuma, Dean J.; Sullivan, John L. (Veterans Administration Hospital, Omaha). Anal. Chem., 40: 974-6(May 1968).

A radiochemical separation procedure for ^{64}Cu, ^{27}Mg, ^{69m}Zn, and ^{56}Mn is described that makes possible the determination of these elements by neutron activation methods although the half-life of ^{27}Mg is short and the principal photopeak is practically superimposed on ^{56}Mn. The method consists of extraction of copper dithizonate, zinc dithizonate, magnesium thenoyltrifluoroacetone, (possibly as butylammonium $Mg(TTA)_3$), and manganese diethyldithiocarbamate. Copper is extracted first, then Zn, Mn, and Mg, respectively. The γ-activities are measured in the order ^{64}Cu, ^{27}Mg, ^{69m}Zn, and ^{56}Mn. The average chemical yield for Cu, Zn, and Mn was better than 95%. The overall yield of Mg was 91%. Tabulated results for tissue analysis and recoveries from tissue are presented. (D.H.M.)

25262 DETERMINATION OF MERCURY IN AQUEOUS SAMPLES BY MEANS OF NEUTRON ACTIVATION ANALYSIS WITH AN ACCOUNT OF FLUX DISTURBANCES. Brune, D.; Jirlow, K. (Aktiebolaget Atomenergie, Stockholm. Aktiebolaget Atomenergie, Studsvik, Sweden). Radiochim. Acta, 8: 161-4 (Dec. 1967). (AE-290).

The technique of low-temperature neutron irradiation combined with isotopic exchange separation technique was applied in the determination of mercury in aqueous samples. The kinetics of the isotopic exchange reaction were studied for various sample volumes. The effect of the flux perturbation caused by aqueous samples was investigated for samples of various size and geometry in a central position in a well-moderated heavy-water reactor. The effect was studied both theoretically and experimentally. The "Thermos" code was used in the calculations. (auth)

25263 LOSS OF ^{210}Po ON DRY ASHING RAT TISSUES IN A MUFFLE FURNACE. Cleary, J. J.; Hamilton, E. I. (Radiological Protection Service, Sutton, Eng.). Analyst, 93: 235-6(Apr. 1968).

From the studies described it was found that losses occur at lower temperatures than generally stated in the literature. (auth) (UK)

25264 DETERMINATION OF ^{227}Ac IN URINE. Gomm, P. J.; Eakins, J. D. (Atomic Energy Research Establishment, Harwell, Eng.). Analyst, 93: 228-34(Apr. 1968).

After oxidation of the urine sample with nitric acid, actinium was co-precipitated on barium sulphate. The barium sulphate was converted into carbonate, dissolved in acid and the actinium co-precipitated on iron(III) hydroxide to remove barium and radium. The iron(III) hydroxide precipitate was dissolved in a mixture of nitric and hydrochloric acids and the solution passed through an anion exchange column upon which iron, thorium, and protactinium were absorbed. The column effluent, which contained the actinium was essentially free from solids. Sources for α-counting were prepared either by evaporation or by electrodeposition. Actinium recoveries of about 80% were obtained, with good decontamination from protactinium, thorium, radium, polonium, and lead. (auth) (UK)

25265 TITRIMETRIC DETERMINATION OF MOLYBDENUM IN AMMONIUM MOLYBDATE, MOLYBDIC ACID, AND MOLYBDENUM TRIOXIDE WITH SODIUM HYDROXIDE. Burns, D. Thorburn (Univ. of Tech., Loughborough, Eng.); Deadman, P.; Clark, J. A. Analyst, 93: 249-51(Apr. 1968).

Attempts to develop titrimetric methods of assaying molybdates based on their reactions with sodium hydroxide solution are described. (auth) (UK)

25266 FUNDAMENTALS OF THE ANALYTICAL USE OF THE REVERSED SCATTERING OF β RADIATION. Krivan, V. (Inst. of Chemistry and Tech., Bratislava). Chem. Listy, 62: 129-52 (Feb. 1968). (In Czech).

A brief review is given on principles and analytical uses of β radiation backscattering. Radioisotopic methods in research and industry are discussed. Automatic control, isotopic tracers, and effects of β radiation reflection in fast analysis of complex systems are reviewed. (129 references) (R.V.J.)

25267 DETERMINATION OF SODIUM IN HIGH-PURITY SILICA BY ACTIVATION ANALYSIS. Kenna, B. T.; Conrad, F. J. (Sandia Lab., Albuquerque, N. Mex.). Talanta, 15: 418-20(Apr. 1968).

High purity fused silica samples and NBS standards were irradiated in the Sandia Reactor Facility for 2 hr at a thermal-flux of 10^{10} neutrons/cm^2/sec. Sodium-24 was produced by the reaction $^{23}Na(n,\gamma)^{24}Na$ (14.9 hr half-life, σ = 0.5 barn), and decayed with emission of 1.37 and 2.75 MeV γ-rays. With the stated flux and irradiation time, sodium at the 3 ppM level was determined with a standard deviation of 0.2 ppM. Values obtained by thermal neutron activation analysis agree well with results obtained by emission spectrography and flame spectrophotometric methods. (auth) (UK)

25268 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM IN ZIRCONIUM, TITANIUM, AND OTHER METALS WITH 4-(2-PYRIDYLAZO)RESORCINOL. Wood, D. F.; Jones, J. T. (Imperial Metal Industries Ltd., Birmingham, Eng.). Analyst, 93: 131-41(Mar. 1968).

A reaction based on the formation of a purple-colored complex between niobium and 4-(2-pyridylazo)resorcinol (PAR) in a tartrate-(ethylenedinitrilo) tetraacetic acid (EDTA) solution was successfully applied to the direct spectrophotometric determination of niobium, in the range 50 ppM to about 1 percent, in zirconium, zirconium alloys, hafnium, tungsten, and molybdenum. The absorbance was measured at 550 mμ. By modification, this direct procedure can be used for the determination of down to 200 ppM of niobium in titanium and its alloys. Following an extractive concentration, amounts of niobium down to about 10 ppM can be determined in titanium, zirconium, and their alloys, and in hafnium, molybdenum and iron. For tungsten and molybdenum, a preliminary collection of niobium on zirconium hydroxide is recommended. The effects of common alloying elements and likely impurities were investigated. The absorption of the tantalum complex was only about one eighth of that of the niobium-PAR complex. (auth) (UK)

25269 USE OF o-NITROBENZOIC ACID FOR GRAVIMETRIC DETERMINATION OF ZIRCONIUM OR HAFNIUM. Kuleva, V. M.; Popova, A. N. (Leningrad Pedagogical Inst.). Zh. Anal. Khim., 21: 46-52(1966). (In Russian).

The following procedure is reported for the gravimetric determination of Zr or Hf. Make the test solution 2M in HCl, heat just to the boiling point and add 5 g of NH_4Cl or NH_4NO_3 per 100 ml of solution (as coagulating agent). Then add, dropwise and with stirring, hot 1.5% aqueous o-nitrobenzoic acid in 50-fold or 100-fold excess for Zr or Hf, respectively, and heat on a water bath until coagulation of the precipitate is complete. Filter off the precipitate, keeping the mixture hot during the filtration to prevent crystallization of the excess precipitant; dry the precipitate in air, moisten it with 2 or 3 drops of concentrated H_2SO_4 or HNO_3 (or cover it with a thin layer of oxalic acid) to avoid losses during the subsequent ignition, and ignite it in a muffle-furnace at 1000°C. Weigh the cooled residue as ZrO_2 or HfO_2. When ≈4 to 150 mg of ZrO_2 or ≈4 to 35 mg of HfO_2 was determined, the absolute error was ± +0.2 mg. Titanium, Sn^{IV}, Sn^{II}, SO_4^{2-}, oxalate, tartrate, citrate, EDTA, and H_2O_2 must be absent, and double precipitation is necessary if Th, Fe^{III}, or Cr^{III} is present. (Anal. Abstr.)

25270 CATHODE-RAY-EXCITED EMISSION SPECTROSCOPIC ANALYSIS OF TRACE RARE EARTHS. PART I. QUALITATIVE STUDIES. Larach, Simon (RCA Labs., Princeton, N. J.). Anal. Chim. Acta, 41: 189-95(May 1968).

Line emissions from f-f transitions in rare earths contained in a matrix were obtained by excitation with cathode rays. The distinctive energy of these emissions was utilized to detect the presence of trace amounts of rare earths, and non-destructive identification of such traces was carried out quickly by comparison with a derived hauptlinien spectrum. Matrix effects, masking interferences and the utilization of line shape are discussed. (auth)

25271 BIOCHEMICAL ANALYSIS. D'Eustachio, Anthony J. (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). Anal. Chem., 40: 19R-32R(Apr. 1968).

Significant developments in biochemical analysis from January, 1966 through December, 1967 are reviewed. Topics discussed are: new books and journals; dialysis and ultrafiltration; centrifugation; electrophoresis; column chromatography: ion exchange and gel filtration; paper chromatography and thin-layer chromatography; gas chromatography; spectrophotometry: ultraviolet, infrared, atomic absorption, fluorescence, and luminescence; radiometric analysis: electron, microprobe, and neutron activation analysis; mass spectrometry; electron microscope, lasers; magnetic resonance; electrochemical methods; gasometric analysis; and, instrumentation and automation. (683 references) (J.G.B.)

25272 DETERMINATION OF POTASSIUM IN THE MEDIUM RANGE BY ITS NATURAL GAMMA RADIOACTIVITY. Lanfranco, Giovanni (Centro Ricerche Metallurgiche, Turin). Chim. Ind. (Milan), 49: 742-5(July 1967). (In Italian).

Results of determination of β and γ radioactivity in the analysis of samples containing K are presented. Gamma activity is a linear function of K concentration per unit volume; β activity is measured under the usual conditions so that activity is linear with concentration per unit mass. Sensitivity for the determination of K is

greater for β measurements. Measurements of γ activity are necessary when heavy elements or radioactive materials are present in the sample. Instrumentation is briefly discussed, calibration curves established, and several practical examples illustrated. The latter include samples of lead glass and clay; results are compared with chemical analysis. Operating time for γ determination is 400 min and for β determination is 10,000 sec. (BBB)

25273 DETERMINATION OF OXYGEN AND NITROGEN IN NIOBIUM BY SPARK SOURCE MASS SPECTROGRAPHY. Vidal, Georges; Galmard, Pierre; Lanusse, Pierre. Recherche Aerospatiale (France), 33-41(Nov.-Dec. 1967). (In French).

Spark-source mass spectrography was used during the last few years for determination of traces of impurities in solids. The work of authors who used this method for gas analysis is reviewed. The results obtained by this method in determining the oxygen and nitrogen in ten niobium samples are indicated. The mean values obtained using mass spectrography differ by a factor of two approximately from the results given by other methods. However there is a large dispersion, which, because of the pinpoint character of the analysis, may originate in the microsegregations of these elements in niobium. (auth) (IAA)

25274 GAS CHROMATOGRAPHY. Juvet, Richard S. Jr. (Univ. of Illinois, Urbana); Dal Nogare, Stephen. Anal. Chem., 40: 33R-50R(Apr. 1968).

The most significant literature of the years 1966-67 in the field of gas chromatography is reviewed. Column theory, liquid phases, solid supports, adsorbents, carrier gases, sample introduction, and trapping procedures for packed columns are discussed. Current applications of detectors, quantitative and qualitative measurements, and specialized operations and equipment such as open tubular columns, temperature and flow programming, and pyrolysis are reviewed. Applications of gas chromatography to the separation of metallic compounds and biochemical compounds are discussed. (667 references) (J.G.B.)

25275 ION EXCHANGE CHROMATOGRAPHY. Walton, Harold F. (Univ. of Colorado, Boulder). Anal. Chem., 40: 51R-62R(Apr. 1968).

Topics included for discussion are: books, reviews, and journals; theory; techniques; new exchange materials: inorganic, resinous, cellulosic, and liquid ion exchangers; paper and thin-layer chromatography; and, chromatography of inorganic ions and organic compounds. (372 references) (J.G.B.)

25276 RADIOCHEMICAL DETERMINATION OF NUCLIDES OF LONG HALF-LIFE IN A TANTALUM CONVERTER IN THE FRASCATI ELECTROSYNCHROTRON. di Napoli, Vito; Dobici, Franco; Forina, Odetta; Salvetti, Franco (CNEN, Rome). Gazz. Chim Ital., 97: 207-13(Feb. 1967). (In Italian).

The radiochemical analysis of a Ta converter in the electrosynchrotron at Frascati is reported. Studies were carried out by solution of the sample, chemical separations, and γ spectrometry. Study of decays of peaks in the γ spectrum led to the following assignments for elements, their half lives, and E_γ (in MeV): ^{175}Hf, 70 days, 0.11, 0.24; ^{172}Hf, 5 years, -; ^{172}Lu, 6.7 days, 0.81, 0.90, 1.09; ^{169}Yb, 32 days, 0.20, 0.31, 0.41. These are in good agreement with the literature. Short-lived isotopes were not included in the study, although part of the remaining activity is likely due to these causes. Illustrations of the γ spectra of the freshly dissolved sample, of the Hf precipitate, and of the rare earth precipitate are given. (BBB).

25277 NEUTRON ACTIVATION ANALYSIS OF TRACES IN ELECTROLYTIC ZINC SULPHATE SOLUTIONS. PART III. SIMULTANEOUS DETERMINATION OF TELLURIUM, SELENIUM, ARSENIC, AND ANTIMONY. Dams, R.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 41: 205-15(May 1968).

A neutron activation analysis is described for the simultaneous determination of tellurium, selenium, arsenic, and antimony in an electrolytic zinc sulfate solution. The activity induced in the tellurium was measured by means of its radioactive daughter ^{131}I. The chemical separation of iodine was performed by extraction into carbon tetrachloride. The interference due to the fission of uranium was minimized by a pre-separation of uranium. The isotope ^{75}Se was measured by a γ-γ coincidence technique, which allowed the determination of 0.002 μg Se/ml. Selenium was chemically separated by extraction as piazselenol. Arsenic and antimony were separated by precipitation as sulfide and distillation as chloride. The isotopes ^{76}As and ^{122}Sb were measured γ-spectrometrically, amounts of 0.02 μg/ml being determined. The method is also suitable, although not very sensitive, for the simultaneous determination of tin and germanium. (auth)

25278 BIOLOGY AND NEUTRONIC RADIATION: THE AGRONOMICAL APPLICATIONS OF ANALYSIS BY RADIOACTIVATION. Fourcy, Andre (Univ., Grenoble, France). Ind. At., 11: No. 11-12, 39-46(1967). (In French).

In the framework of the applications of nuclear energy to the biology of plants and agronomy, analysis is a method susceptible of numerous developments. After a brief description of the material and techniques used for neutron activation analysis, some application examples are given: physiology of mineral nutrition, use of pesticides, and determination of trace elements and diverse pollutions. (tr-auth)

25279 SPECTROFLUORIMETRIC DETERMINATION OF TRACE AMOUNTS OF CERIUM IN YTTRIUM OXIDE. Cukor, Peter; Weberling, R. P. (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Anal. Chim. Acta, 41: 404-7(May 1968).

A rapid, direct method for the determination of cerium in yttria is described. It is based on dissolution in perchloric acid, reduction of Ce(IV) to Ce(III), and measurement of the fluorescence of Ce(III) with 260 nm as the excitation wavelength and 355 nm as the emission wavelength. With this method the detection of 0.1 μg of Ce per gram of Y_2O_3 was possible. Iron(III) was found to interfer, however, titanium(III) sulfate employed as a reductant not only reduced Fe(III) quantitatively, but did not affect the fluorescence of Ce(III). The accuracy and precision of the method was found to be $\pm$10% and the standard deviation for the 5 μg level was 6%. (D.H.M.)

25280 DETERMINATION OF LANTHANUM IN TITANIA BY ACTIVATION ANALYSIS. Massart, D. L.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 41: 378-80(May 1968).

A neutron activation method for determining the lanthanum in titanium is described that includes a radiochemical separation process. The cross section for (n,γ) capture of titanium is 8 barns. From this value it was calculated that no appreciable self-shielding occurred in the sample. (D.H.M.)

25281 STUDY OF THE REACTIONS OF SOME METAL IONS AND MIXTURES OF METAL IONS WITH CUPFERRON BY HIGH-FREQUENCY TITRATION. Riolo, Carla Bertoglio; Soldi, Teresa Fulle; Spini, Giovanni (Univ., Pavia, Italy). Anal. Chim. Acta, 41: 388-91(May 1968).

The formation of the 1:1 and 1:2 molybdenum(VI)–cupferron complexes, the 1:2 uranium(VI)–cupferron complex, and the 1:2 thorium(IV)–cupferron complex was studied by means of high-frequency titrations. The formation of the U(IV)–cupferron complex was confirmed colorimetrically and the molybdenum complexes were studied potentiometrically. It proved possible to analyze mixtures of iron(III) with various other ions (including Ti, V, Mo, Th, and Zr) by high-frequency titrations when hydrogen peroxide was used as masking agent. Appropriate pH adjustments allowed the analysis of U(VI)/V(V), U(VI), U(VI)/Mo(VI), and V(V)/V(IV) mixtures. The experimental error did not exceed 0.5% and the minimum concentration that could be determined was 5×10^{-5} M. (D.H.M.)

25282 FLUORIMETRIC DETERMINATION OF TUNGSTEN IN ALMOST PURE TUNGSTEN, THORIATED TUNGSTEN, AND Co–Ni–Cr REFRACTORY ALLOYS. Bottei, Rudolph S.; Trusk, Ambrose (Univ. of Notre Dame, Ind.). Anal. Chim. Acta, 41: 374-7(May 1968). (COO-38-585).

Results from the fluorimetric determination of tungsten with flavonol in almost pure tungsten, thoriated tungsten, and Co–Ni–Cr refractory alloy are reported. After the sample was dissolved in a mixture of hydrofluoric and nitric acid, perchloric acid was added and the mixture was gently fumed. When a precipitate began to form, sodium hydroxide and phenolphthalein were added and the test solution prepared for fluorimetric readings. The standard deviation was 0.08 for the almost pure tungsten; 0.07 for the thoriated tungsten; and 0.09 to 0.16 for the Co–Ni–Cr alloys. The samples used contained about 4% tungsten; however, the procedure could be applied to alloys of higher or lower tungsten content. (D.H.M.)

25283 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM IN STEELS WITH 4-(2-PYRIDYLAZO)-RESORCINOL. Pakalns, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Anal. Chim. Acta, 41: 283-92(May 1968).

A direct method is presented for the spectrophotometric determination of niobium with PAR in mild and alloy steels. Interference is caused only by tantalum and large amounts of copper. A compensating solution is used to correct for colored ions and for the copper–PAR complex. The method covers the range 0 to 100 μg of niobium, and Beer's law is obeyed from 0 to 2.0 μg Nb/ml. A molar absorptivity of 14,400 at 536 nm was found for the niobium–PAR complex, with a relative standard deviation of $\pm$0.6%. (auth)

25284 SINGLE-STEP RADIOCHEMICAL SEPARATIONS BY COLUMN PROCEDURES IN ACTIVATION ANALYSIS. Malvano, R.; Grosso, P.; Zanardi, M. (Centro Ricerche Nucleair, Sorin, Italy). Anal. Chim. Acta, 41: 251-8(May 1968).

Some single-step column procedures are described for both individual and group activity separations. Besides the usual ion exchange techniques, other methods such as reverse-phase chromatography, isotopic exchange and the use of resins converted into special forms were used. Fast and simple selective separations from 2 N hydrochloric acid are reported for Mo(VI), Au, Cu(II), Sb(V), and for AsO_4^{3-} + PO_4^{3-} from both 2 N hydrochloric acid and 1 N sulfuric acid; for Cu, Sb and As + P, the selectivity can be greatly increased by using a guard bed of resin in normal form. By combining the different techniques a single-step separation scheme for 6 elements (Mo, Au, Zn, As, Cu, Sb) in 2 N hydrochloric acid was developed; this allows high chemical recoveries, high cross-decontamination and very large decontamination from ^{24}Na to be reached, so that application for biological sample analysis can be envisaged. Simplified two-stage column separations for Au + Sb and Cu and Fe + Sb and Zn from concentrated hydrochloric acid (cationic and anionic resin beds coupled) are also reported. (auth)

25285 DETERMINATION OF TRACE ELEMENTS IN INORGANIC AND ORGANIC MATERIALS BY X-RAY FLUORESCENCE SPECTROSCOPY. Luke, C. L. (Bell Telephone Labs. Inc., Murray Hill, N. J.). Anal. Chim. Acta, 41: 237-50(May 1968).

A method for the trace analysis of inorganic and organic materials is described. The trace element (or elements) together with a suitable coprecipitating element is isolated from interfering elements by precipitation with a suitable organic or inorganic precipitant. The precipitate is then filtered on a paper disk and the collected trace element (or elements) is determined by x-ray analysis. (auth)

25286 DETERMINATION OF RARE-EARTH ELEMENTS IN ROCK SAMPLES BY NEUTRON ACTIVATION ANALYSIS WITH A LITHIUM-DRIFTED GERMANIUM DETECTOR AFTER CHEMICAL GROUP-SEPARATION. Tomura, Kenji (Rikkyo Univ. Yokosuka, Japan); Higuchi, Hideo; Miyaji, Nobuyoshi; Onuma, Naoki; Hamaguchi, Hiroshi. Anal. Chim. Acta, 41: 217-28 (May 1968).

A lithium-drifted germanium detector combined with chemical group-separation was utilized for the determination of rare earth elements (La, Ce, Nd, Sm, Eu, Gd, Tb, Tm, Yb, and Lu) in rock samples by neutron activation. This procedure has the advantage of a low background level which cannot be attained in the nondestructive method. The combination of the Ge(Li) detector and chemical group-separation also offers a distinct simplification in the correction of contributions from other nuclides. For optimum utility of a Ge(Li) detector in neutron activation analysis, chemical group-separations are recommended. (auth)

25287 DETERMINATION OF URANIUM AND THORIUM MICROGRAM QUANTITIES BY MEANS OF ION EXCHANGE RESINS. Shestakov, G. I. Byull. Kom. Opred. Absol. Geol. Form., 8: 124-30(1967). (In Russian).

A method is given for the quantitative separation of microgram quantities of U, Th, and Pb from hydrochloric acid solutions of various rocks using ion-exchange resins EDE-10P and KU-2. Quantitative chemical determination and isotope dilution methods are described. The suggested analytical method was found to be much more sensitive than ordinary methods. (R.V.J.)

25288 COMPARISON OF RADIOCHEMICAL AND COLORIMETRIC METHODS FOR URANIUM AND THORIUM DETERMINATION. Mirkina, S. L.; Iskanderova, A. D. Byull. Kom. Opred. Absol. Geol. Form., 8: 119-23(1967). (In Russian).

The mathematically treated results of radiochemical analysis of 127 mineral specimens and 20 carbonaceous rocks and colorimetric determination of thorium with arsenazo III in a FEK-MI red light filter in a 50 mm thick vessel and uranium with arsenazo III according to the violet color of tetravalent uranium in a FEK-MI with 22 mm layer vessel are tabulated. Data obtained show that for uranium both methods produce identical results, however, in a specimen with U content of 1×10^{-4}% the radiochemical determination results in a higher order of error. The specimens containing centesimal amounts of thorium, both methods are identical but for minerals containing lower contents of Th the colorimetric method proved more sensitive. (R.V.J.)

25289 NEUTRON ACTIVATION ANALYSIS OF TRACES IN ELECTROLYTIC ZINC SULPHATE SOLUTIONS. PART , DETERMINATION OF MOLYBDENUM AND RHENIUM. Dams, R.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 41: 197-204 May 1968).

A neutron activation analysis was devised for the determination of traces of molybdenum and rhenium in an electrolytic zinc sulfate solution. The activities due to the daughter ^{99m}Tc and to ^{186}Re were counted. The chemical separation was performed on an anion exchange resin. The matrix activities were separated by elution with 0.5 N nitric acid. The separation of technetium and rhenium was performed by an elution with 0.2 N perchloric acid. To avoid errors in the molybdenum determination, the uranium present in the sample was separated before the irradiation. (auth)

25290 KINETIC ASPECTS OF ANALYTICAL CHEMISTRY. Rechnitz, Garry A. (State Univ. of New York, Buffalo). Anal. Chem., 40: 455R-8R(Apr. 1968).

Kinetic aspects of analytical chemistry, including discussions of analysis by kinetic methods and studies of analytical reactions, are reviewed. (83 references) (J.G.B.)

25291 USE OF ENZYMES IN ANALYTICAL CHEMISTRY. Guilbault, George G. (Louisiana State Univ., New Orleans). Anal. Chem., 40: 459R-71R(Apr. 1968).

The following topics are discussed in a review of the uses of enzymes in analytical chemistry: books and reviews; sources of reagents; methodology; determination of enzymes, by methods including fluorometric, electrochemical, radiochemical, and others; determination of substrates; coenzymes and activators; inhibitors; immobilization of enzymes; and automatic methods. (366 references) (J.G.B.)

25292 ELECTROCHEMICAL RELAXATION TECHNIQUES. Reinmuth, W. H. (Columbia Univ., New York). Anal. Chem., 40: 185R-94R(Apr. 1968).

A survey of the literature published during 1966 and 1967 is presented. Topics discussed are: small amplitude relaxations; large amplitude controlled current techniques; coulostatics; potentiodynamics; potentiostatics; thin layer cells; hydrodynamic electrodes; and photons and relaxations. (201 references) (J.G.B.)

25293 ORGANIC POLAROGRAPHY. Pietrzyk, Donald J. (Univ. of Iowa, Iowa City). Anal. Chem., 40: 194R-223R(Apr. 1968).

Recent developments in organic polarography for reversible and irreversible systems are reviewed. (1475 references) (J.G.B.)

25294 EMISSION SPECTROMETRY. Margoshes, Marvin; Scribner, Bourdon F. (National Bureau of Standards, Washington, D. C.). Anal. Chem., 40: 223R-46R(Apr. 1968).

Developments in emission spectrometry and the related techniques of atomic absorption and atomic fluorescence spectrometry for the years 1966 and 1967 are reviewed. Topics discussed are: books and reviews; spectral descriptions and classifications; instrumentations; standards, samples, calibration; excitation sources; flame emission, absorption, and fluorescence; trace analysis; lasers and microanalysis; and, other applications. (676 references) (J.G.B.)

25295 INFRARED SPECTROMETRY. Crisler, R. O. (Procter and Gamble Co., Cincinnati). Anal. Chem., 40: 246R-54R (Apr. 1968).

Significant developments in infrared spectrometry during 1966 and 1967 are reviewed. Topics discussed are: books and reviews; techniques and instrumentation; computer aided spectroscopy; interferometry; attenuated total reflectance; analytical methods; and correlations, assignments, and structure. (184 references) (J.G.B.)

25296 LIGHT ABSORPTION SPECTROMETRY. Boltz, D. F. (Wayne State Univ., Detroit); Mellon, M. G. Anal. Chem., 40: 255R-73R(Apr. 1968).

Developments in light absorption spectrometry are reviewed. The chemistry of spectrophotometric determinations of metals, nonmetals, and organic constituents are discussed. Subject matter pertaining to the measurement of radiant energy in the visible region and recent developments in instrumentation and special methodology are also included. (803 references) (J.G.B.)

25297 MASS SPECTROMETRY. Kiser, Robert W.; Sullivan, Richard E. (Univ. of Kentucky, Lexington). Anal. Chem., 40: 273R-302R(Apr. 1968).

Significant developments in mass spectrometry for the 1966–67 period are reviewed. Topics discussed are: instrumentation; surface ionization; spark source mass spectrography; field ionization; data processing; high-temperature chemistry; discharges, flames, and free radicals; ion-molecule and charge exchange reactions; chemical ionization; metastables; mechanisms; ionization cross sections and ionization efficiency curves; theory of mass spectra; negative ions; neutral fragments and multiply charged ions; energetics; analytical determinations; inorganics and organometallics; mass spectra of organic compounds; and, mass spectral studies of natural products. (1608 references) (J.G.B.)

25298 ELECTROANALYSIS AND COULOMETRIC ANALYSIS. Bard, Allen J. (Univ. of Texas, Austin). Anal. Chem., 40: 64R-74R(Apr. 1968).

Books and review articles and new techniques, such as optical methods of observing electrode-solution interface and digital electrochemical instrumentation, are discussed. Developments in electroseparations and electrogravimetry, controlled potential coulometry, and controlled current coulometry: coulometric titrations are reported. New designs of coulometric titration apparatus and potentiostats are treated briefly. (343 references) (J.G.B.)

25299 ULTRAVIOLET SPECTROMETRY. Crummett, Warren; Hummel, Richard (Dow Chemical Co., Midland, Mich.). Anal. Chem., 40: 330R-45R(Apr. 1968).

Developments in ultraviolet spectrometry during 1966 and 1967 are summarized. Topics discussed are: books and reviews; collections of spectra and indices; apparatus; spectral studies of classes of compounds; adsorbed molecules and crystals; vacuum ultraviolet spectral data; solvent and pH effects; solution equilibria; reaction mechanisms; reaction rates; proof of structure; theory and calculations; complexes; inorganic analysis; organic analysis; and biological and pharmeceutical analysis. (671 references) (J.G.B.)

25300 X-RAY ABSORPTION AND EMISSION. Campbell, William J. (Bureau of Mines, College Park, Md.); Brown, James D. Anal. Chem., 40: 346R-75R(Apr. 1968).

The following topics are discussed in a review of literature dealing with x-ray absorption and emission: instrumentation; quantitative analysis; low energy x rays and electrons; energy dispersion x-ray analysis using radioactive sources; and electron probe microanalysis. (695 references) (J.G.B.)

25301 AMPEROMETRIC TITRATIONS. Stock, John T. (Univ. of Connecticut, Storrs). Anal. Chem., 40: 392R-401R (Apr. 1968).

Amperometric titrations are reviewed in a discussion of the following topics: apparatus and methodology, acid-base reactions, precipitation and complexing reactions, and oxidation-reduction reactions. (342 references) (J.G.B.)

25302 POTENTIOMETRIC TITRATIONS. Toren, E. Clifford Jr. (Duke Univ., Durham, N. C.). Anal. Chem., 40: 402R-12R(Apr. 1968).

Titration curves and equilibrium calculations for acid-base, polyelectrolyte, complexiметric, and redox titrations are reviewed. Various types of electrodes, including glass, liquid-liquid ion exchange, precipitate and solid state and other hydrogen ion electrodes, metal indicator, and reference electrodes are discussed. Solvents and reagents, techniques other than classical potentiometric titrations, apparatus, and applications to inorganic and organic compounds are reviewed. (288 references) (J.G.B.)

25303 VOLUMETRIC AND GRAVIMETRIC ANALYTICAL METHODS FOR ORGANIC COMPOUNDS. Smith, Walter T. Jr.; Wagner, William F.; Patterson, John M. (Univ. of Kentucky, Lexington). Anal. Chem., 40: 412R-18R(Apr. 1968).

Significant literature for the 1966–67 period is reviewed. Techniques for the determination of certain elements and functional groups in organic compounds are discussed. (151 references) (J.G.B.)

25304 TITRATIONS IN NONAQUEOUS SOLVENTS. Harlow, Gerald A.; Morman, Donald H. (Shell Development Co., Emeryville, Calif.). Anal. Chem., 40: 418R-28R(Apr. 1968).

Significant developments in studies of nonaqueous titrations are reviewed. Topics treated are: theoretical considerations, including acid-base equilibria and interpretation of titration curves, solvation effects and intersolvent comparison of acidity, acidity functions, and conductance and other fundamental data; end point techniques used in thermometric, cryoscopic, and high frequency titrations; methods and applications; and books and reviews. (248 references) (J.G.B.)

25305 ELECTROPHORESIS. Strickland, R. D. (Veterans Administration Hospital, Albuquerque, N. Mex.). Anal. Chem., 40: 74R-116R(Apr. 1968).

Fundamental developments, apparatus, stabilizing media, and buffers and solvents for use in electrophoresis are discussed. Biological applications of electrophoresis are reviewed at length. (2703 references) (J.G.B.)

25306 FLUOROMETRIC ANALYSIS. White, Charles E. (Univ. of Maryland, College Park); Weissler, Alfred. Anal. Chem., 40: 116R-35R(Apr. 1968).

Significant literature on fluorometric analysis of the 1966–67 period is reviewed. Apparatus and specific analysis of various inorganic complexes and biological and organic compounds are discussed. (741 references) (J.G.B.)

25307 ION EXCHANGE. Kunin, Robert; Gustafson, Richard L. (Rohm and Haas Co., Philadelphia). Anal. Chem., 40: 136R-8R(Apr. 1968).

Recent developments in ion exchange techniques and theoretical studies are reviewed. Uses in inorganic, organic, pharmaceutical, and biological analyses are discussed. New ion exchange materials are included. (91 references) (J.G.B.)

25308 INORGANIC MICROCHEMICAL AND TRACE ANALYSIS. West, Philip W. (Louisiana State Univ., Baton Rouge); West, Foymae K. Anal. Chem., 40: 138R-47R(Apr. 1968).

A review of developments in inorganic microchemical and trace analysis during 1966–67 is presented. Topics included for discussion are: optical methods, electroanalytical methods, apparatus separations, masking, ring oven methods, volatilization methods, reagents, spot tests, and catalytic methods. (240 references) (J.G.B.)

25309 ORGANIC MICROCHEMISTRY. Ma, T. S. (Queen's Coll., New York); Gutterson, Milton. Anal. Chem., 40: 147R-58R(Apr. 1968).

Recent developments in the microchemical analysis of organometallic and organic compounds, including radiochemical techniques are reviewed. Simultaneous determinations of several elements within one sample and determinations below the milligram range are discussed. (317 references) (J.G.B.)

25310 CHEMICAL MICROSCOPY. Cocks, George G. (Cornell Univ., Ithaca, N. Y.). Anal. Chem., 40: 158R-67R (Apr. 1968).

Meetings and symposia and books and articles of general interest to those in the field of chemical microscopy are reviewed. Topics discussed are: optics; instruments, including microscopes, stages, and miscellaneous accessories; polarized light, ultraviolet light, phase contrast, interference, and wavefront reconstruction microscopy; dispersion staining; fluorescence microspy; microphotometry and microspectrophotometry; darkfield and ultramicroscopy; and specimen preparation and examination techniques. Applications of chemical microscopy to crystallography, defect structures in crystals, and studies on resins and polymers, metals, and miscellaneous materials are discussed. (246 references) (J.G.B.)

25311 NUCLEONICS. Lyon, W. S.; Ricci, E.; Ross, H. H. (Oak Ridge National Lab., Tenn). Anal. Chem., 40: 168R-74R (Apr. 1968). (ORNL-P-3644).

Topics discussed are: semi-conductor devices; measurement improvements; computer applications; remote analysis; x-ray fluorescence; absolute measurement of radioactivity; liquid scintillation counting; electron spectroscopy for chemical analysis; substoichiometry; radiometric titrations; tracer applications; new techniques; activation analysis; study and correction of errors in activation analysis; and, biological and forensic activation analysis. A bibliography on books, monographs, bibliographies, reviews, and proceedings dealing with nucleonics is included in tabular form. (171 references) (J.G.B.)

25312 POLAROGRAPHIC THEORY, INSTRUMENTATION, AND METHODOLOGY. Hume, David N. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-905. Anal. Chem., 40: 174R-85R(Apr. 1968). (MIT-905-109).

This review is concerned with developments in classical polarography and new electroanalytical techniques of a basically polarographic nature. Topics discussed are: instruments and apparatus half-wave potentials, currents, absorption, maxima, iR drop compensation, differential polarography, chronoamperometry, inverse polarography, alternating current polarography, pulse polarography, square wave, oscilloscopic polarography, chronopotentiometry, and diverse electrodes. (248 references) (J.G.B.)

25313 VOLUMETRIC AND GRAVIMETRIC ANALYTICAL METHODS FOR INORGANIC COMPOUNDS. McCurdy, W. H. Jr. (Univ. of Delaware, Newark). Anal. Chem., 40: 608R-17R (Apr. 1968).

Literature published during 1966–67 and dealing with new or improved approaches to gravimetric or titrimetric analyses of inorganic compounds is reviewed. (239 references) (J.G.B.)

25314 CHROMATOGRAPHY. Zweig, Gunter (Syracuse Univ. Research Corp., N. Y.). Anal. Chem., 40: 490R-521R (Apr. 1968).

Developments in certain areas of the field of chromatography are reviewed. Topics discussed are: column chromatography; gel filtration; gel permeation chromatography; paper chromatography;

thin-layer chromatography; and applications to the separation of various compounds. (1753 references) (J.G.B.)

25315 EXTRACTION. Freiser, Henry (Univ. of Arizona, Tucson). Anal. Chem., 40: 522R-53R(Apr. 1968).

A review of distribution studies, extraction procedures, and multielement separations is presented in tabular form. Topics discussed are: reviews and books, kinetic factors in extraction, process of extraction, extraction systems, and apparatus and techniques. (1138 references) (J.G.B.)

25316 ELECTRON-BEAM ZONE PURIFICATION AND ANALYSIS OF TUNGSTEN. Hay, D. R.; Skogerboe, R. K.; Scala, E. (Drexel Inst. of Tech., Philadelphia). J. Less-Common Metals, 15: 121-7(June 1968).

Mass spectrographic, combustion-chromatographic, inert-gas fusion, and colorimetric techniques of analysis were applied to the determination of impurities in zone-melted tungsten. The mass spectrograph, in sampling only small quantities of the specimen, revealed that the impurity distribution was in general inhomogeneous. The results indicated that only the most refractory impurities were redistributed by zone refining and that the primary mechanism of removal is generally by volatilization. (auth)

25317 DETERMINATION OF MERCURY BY ACTIVATION ANALYSIS. Kukula, F.; Krivanek, M. (Inst. for Nuclear Research, Rez, Czechoslovakia). Isotopenpraxis, 4: 57-9(Feb. 1968). (In Russian).

The determination of mercury by activation analysis is described, based on the substoichiometric separation of mercury diethyldithiocarbamate in alkaline medium. In the presence of ethylene diaminetetraacetic acid and citric acid gold and silver interfere only when present in the analyzed sample in an amount comparable with that of mercury carrier. The method was used to determine mercury in gallium purified by zone melting and in flour. (auth)

25318 DISPOSITION AND DISTRIBUTION OF ANTIMONY IN BILHARZIASIS USING INJECTIONS AND ORAL DRUGS. PART 6. THE CONSTITUTION OF SOME ANTIMONIAL DRUGS THROUGH ANTIMONY DETERMINATION. Abdel-Wahab, M. F.; Mostafa, H. F. (Middle Eastern Regional Radioisotope Centre for Arab Countries, Dokki, Egypt. Drug Research and Control Centre, Giza, Egypt). Isotopenpraxis, 4: 69-72(Feb. 1968).

The constitution of antimonial drugs was examined through antimony determination, using neutron activation analysis for ^{124}Sb determination, N-bromosuccinimide, and polarography. The R_f values of the newly prepared organo-metallic compounds were evaluated and tabulated. (auth)

25319 FURTHER DEVELOPMENT OF AUTOMATIC ACTIVATION ANALYSIS SYSTEM (AAAS) WITH FAST NEUTRONS. Barwinski, A.; Gorski, L.; Janczyszyn, J.; Kwiecinski, St.; Loska, L.; Owsiak, T. (Inst. of Nuclear Techniques, Krakow. Inst. of Nuclear Research, Krakow). Isotopenpraxis, 4: 52-6(Feb. 1968).

Improvement of results of activation analysis were achieved by using a device for simultaneous rotation of the sample around two axes: one parallel and the other perpendicular to the target during the irradiation. A change of the construction of the container resulted in the increase of its volume and a decrease in the mean sample-to-target distance. The distribution of the neutron flux along the axis of the container during the irradiation was measured. An arrangement for automatic loading and unloading of samples is also described. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 25235, 25299, 25310, 25374, 25423, 25431, 25440, 25441, 25451, 25462, 25611, 26056, 26073, 26074, 26275, 26318, and 27396.

25320 (AERE-R-5671) THE REACTION BETWEEN $SrTiO_3$ AND ZIRCONIUM, AND STUDIES WITHIN THE SYSTEM $SrO-TiO_2-ZrO_2$. Henney, J.; Jones, J. W. S. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 13p. Dep. CFSTI. UK.

The reaction in vacuo between $SrTiO_3$ and zirconium was studied over the temperature range from 950 to 1600°C with specimens containing up to about 20 wt % zirconium. The results show that the zirconium is oxidized to ZrO_2 and suggest that oxygen is first obtained by the reduction of TiO_2 to Ti_3O_5 and then by the reduction of SrO with the subsequent loss of strontium by evaporation. This process is accompanied by fairly large volume expansions of the specimens. Studies were also made within the $SrTiO_3-SrZrO_3-ZrO_2-TiO_2$ system and tentative phase diagrams were drawn. It was found that the lattice parameters of solid solutions in the $SrTiO_3-SrZrO_3$ system show a positive deviation from Vegards Law. (auth)

25321 (ANL-7375, pp 95-134) MATERIALS CHEMISTRY AND THERMODYNAMICS. (Argonne National Lab., Ill.).

Developments are reported for studies on: thermodynamics of urania; $U-UO_2$ phase diagram; congruently vaporizing composition of UO_2; factors influencing the compositional (O/U) analysis of UO_2; heat of formation of $UO_3(g)$; vaporization of UP; mass spectrometry of $Re-ReO_2$-vapor and ReO_2-ReO_3-vapor systems; high temperature Pu studies; chemistry of irradiated ceramic fuel; electron microprobe studies; demonstration of fluidized-bed process for preparation of (U,Pu)C; reactivity of fluidized-bed carbide with glovebox atmosphere; pressing and sintering of (U,Pu)C irradiation test fuel; thermodynamics; large-scale preparation of carbides by fluidized-bed techniques; enthalpies of formation of ThF_4, CF_4, rare earth trifluorides; and uranium compounds; thermochemistry of plutonium compounds; 1500°C drop calorimeter; electron-beam-heated calorimetric system; and liquid sodium coolant chemistry. (P.C.H.)

25322 (BMwF-FBK-68-03) ZUR CHEMIE DES PROMETHIUMS. (The Chemistry of Promethium). Scherer, V. (Munich Univ. (West Germany). Institut fuer Anorganische Chemie). Feb. 1968. 91p. (In German). Dep.

The following promethium salts were prepared and studied by x-ray crystallographic methods: PmF_3; $PmCl_3$; $PmBr_3$; PmOF; PmOCl; PmOBr(?); PmOI; $Pm(IO_3)_3 \cdot xH_2O$; A-, B-, and C-Pm_2O_3; $PmXO_4$, where X = P, As, Cr^{5+}, V^{5+}; $PmXO_3$, where X = Sc, B, In, Cr^{3+}; $Pm_2(MoO_4)_3$; $Pm_2(WO_4)_3$; and $Pm_3(CrO_4)_3 \cdot xH_2O$. The following salts of organic acids were obtained and characterized by x-ray methods: $Pm_3(C_2O_4)_3 \cdot 10H_2O$, $Pm_2(CO_3)_3 \cdot 2H_2O$, $Pm(HCOO)_3$, and $Pm(CCl_3COO)_3$. $Pm_2(MoO_4)_3$ and $Pm_2(WO_4)_3$ were shown to emit the characteristic x-rays of molybdenum and tungsten, respectively, which are excited by the ^{147}Pm 223-keV betas. The ionic radius of Pm^{3+} was determined; it shows good agreement with the value predicted by Templeton. (auth)

25323 (CEA-N-616, pp 97-105) ETUDES D'ELECTROCHIMIE. (Electrochemical Studies). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: preparation of uranium by dry electrolysis; and electrochemistry in fused salts and electrocrystallization. (P.C.H.)

25324 (JEN-172-DQ/I-61) ELECTROCHEMICAL BEHAVIOUR OF CADMIUM IN THE H_2O-D_2O SYSTEM. I. POLAROGRAPHIC STUDY. Alonso-Lopez, J. (Junta de Energia Nuclear, Madrid (Spain)). 1966. 7p. Dep. CFSTI.

The diffusion current of Cd^{2+} in a H_2O-D_2O system with a supporting electrolyte of 0.1 M KCl + 0.01 M HCl was studied as a function of parameters such as time, height of the mercury reservoir, and electrolyte temperature. The characteristics of the process are those of a reversible diffusion-controlled process. In the H_2O-D_2O system, the values of the diffusion current were smaller than the corresponding ones in H_2O, at 25°C. The decrease was proportional to D_2O concentration when this was greater than 35%. This fact may be used as an analytical means of determining D_2O in H_2O mixtures. (auth)

25325 (NP-17354) RECUPERACION DE HIDROGENO EN PROCESOS DE REDUCCION. (Recovery of Hydrogen in the Reduction Process). Mallen Garza, Alejandra de la Luz (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica). 1966. 96p. (In Spanish). Dep.

Thesis.

The process of the reduction of UO_3 with hydrogen was studied in order to develop an efficient and economic process for the recovery of the excess hydrogen. The auxiliary equipment designed and constructed for the recovery of hydrogen is described in detail. An economic evaluation is made of the equipment. (J.S.R.)

25326 (NP-17364) ZUR KRISTALLCHEMIE DES RADIUMS. (The Crystal Chemistry of Radium). Trinkl, Anton (Munich Univ. (West Germany)). 1967. 92p. (In German). Dep.

Thesis.

The radium compounds-radium fluoride, anhydrous and hydrated radium chloride, anhydrous radium bromide and the 0.5 hydrate, anhydrous radium iodide and the 0.5 hydrate, radium fluoberyllate, radium oxides, radium sulfide, radium selenide, radium sulfate, radium selenate, radium molybdate, radium tung-

state, radium carbonate, radium nitrate, and radium cerate—were prepared and x-ray structure analyses were made of each. The methods of preparation and the x-ray techniques used are described. The atomic radius of Ra was determined as 2.32 ± 0.1 Å; the ion radius of Ra^{2+}, determined from experimental data on the various radium salts, was 1.371 ± 0.001. (J.S.R.)

25327 (ORNL–4229, pp 3-21) DIRECT SUPPORT FOR MSRE OPERATIONS. (Oak Ridge National Lab., Tenn.).

Chemical behavior of the MSRE fuel, fission product behavior, gas transport in moderator graphite, preparation of fluoride mixtures, phase relations in fluoroborate systems, corrosion of Hastelloy N and its constituents in fluoroborate melts, compatibility of BF_3 with Gulfspin-35 pump oil at 150°F, and compatibility and immiscibility of molten fluorides and fluoroborates are discussed. (M.C.G.)

25328 (ORNL–4229, pp 50-67) CHEMICAL STUDIES OF MOLTEN-SALT SYSTEMS. (Oak Ridge National Lab., Tenn.).

Research progress is reported on: relations between deviations from ideality and association in binary mixtures, thermodynamics of $LiF-BeF_2$ system by emf measurements, vapor pressures and derived thermodynamic information for the system $NaBF_4-NaF$, viscosity and its temperature dependence in molten BeF_2, electric conductivity of molten salts, chemistry of SiO_2 in molten fluorides, spectrophotometric measurements of molten fluorides in silica, evaluation of spectrophotometric containers for molten fluorides, spectroscopic investigation of niobium fluorides in molten salts, and crystal structures of complex fluorides. (M.C.G.)

25329 (ORNL–4229, pp 84-104) CHEMISTRY OF HIGH-TEMPERATURE AQUEOUS SOLUTIONS. (Oak Ridge National Lab., Tenn.).

Research progress is reported on: solubility of Fe_3O_4 at elevated temperatures, the independence of isothermal equilibria in electrolyte solutions on changes in dielectric constant, electric conductances of aqueous electrolyte solutions from 0 to 800°C and to 4000 bars, effect of added electrolytes on the critical temperature of water, activity coefficients and thermodynamic functions of calcium sulfate in an aqueous mixed electrolyte to 350°C, the lanthanum fluoride electrode response in aqueous chloride media, beryllium fluoride complexes in aqueous chloride and perchlorate media, the hydrolysis of beryllium(II) in 1 M NaCl, apparatus for hydrolytic equilibria studies up to about 300°C, apparatus for determining the dissociation constant of water at elevated temperatures, and high-temperature isopiestic studies. (M.C.G.)

25330 (ORNL–4229, pp 105-11) INTERACTION OF WATER WITH PARTICULATE SOLIDS. (Oak Ridge National Lab., Tenn.).

Research progress is reported on interaction of water with particulate solids. Topics covered include: heats of immersion and adsorption in thoria—water systems, the effect of irreversibly adsorbed water on the character of thoria surfaces, infrared spectra of adsorbed species on thoria, and processing of sol-gel UO_2 microspheres. (M.C.G.)

25331 (ORNL–4229, pp 115-18) DIFFUSION PROCESSES. (Oak Ridge National Lab., Tenn.).

Transport properties of gases were studied by research on diffusion in noble gas systems and on thermal transpiration. Investigations were also made on recoil of fission products in heterogeneous carbon structures. (M.C.G.)

25332 (ORNL–4229, pp 156-61) DEVELOPMENT OF DEVICES FOR THE SEPARATION AND MEASUREMENT OF PARTICLES AND FISSION PRODUCTS. (Oak Ridge National Lab., Tenn.).

Research progress is reported on development of devices for the separation and measurement of particles and fission products. Topics covered include: classification of submicron particles by a low-pressure impactor, atmospheric pressure samplers for sizing particulate aerosols, iodine characterization samplers, and fission product deposition characteristics in thermal gradients. (M.C.G.)

25333 (ORNL–4229, pp 162-79) SUPPORTING LABORATORY AND THEORETICAL STUDIES. (Oak Ridge National Lab., Tenn.).

Supporting laboratory and theoretical studies include: mechanisms of sorption of molecular iodine, uptake of methyl iodide from wind tunnel gases by a suspended drop of water, removal of molecular forms of radioiodine from moist air systems, reactions of iodine vapor in containment systems, application of iodized charcoals to air-cleaning systems, effects of water vapor on the volatility of TeO_2, gas-phase composition of the U–O–Sr system in the presence of the condensed phase, calculation of the amount of volatile radioactivity in fuel rod void spaces, prompt release of fission products from highly rated Zircaloy-clad UO_2 fuel, development of filtration technology, and ignition of charcoal adsorbers. (M.C.G.)

25334 (AEC-tr–6934) STUDY OF THE BEHAVIOR OF FISSION PRODUCTS IN LIQUID SODIUM. Barthoux, A.; Saroul, J. Translated for Oak Ridge National Lab., Tenn., from pp 743-57 of STI/PUB–143 presented at Proceedings of IAEA Symposium on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna, November 28–December 2, 1966. 24p. Dep. CFSTI. JCL $2.60 fs, $1.10 mf.

See also CONF-661110–14.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 31031. (P.C.H.)

25335 (ANL-Trans–584) VAPORIZATION OF ACTINIDES AND THEIR COMPOUNDS. III. VAPORIZATION OF SOME COMPOUNDS OF URANIUM. Krivy, I. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Translated for Argonne National Lab., Ill., from report UJV–1783. 60p. Dep. CFSTI. JCL $5.60 fs, $2.00 mf.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 59. (P.C.H.)

25336 ABSORPTION SPECTRA AND A POSSIBLE CLASSIFICATION OF THE ELECTRONIC STATES OF URANYL COMPOUNDS. Volodko, L. V.; Komyak, A. I.; Sleptsov, L. E. Opt. Spectrosc. (USSR) (Engl. Transl.), 23: 397-400(Nov. 1967).

Translated from Opt. Spektrosk., 23: 730-6(Nov. 1967).

An analysis of electronic vibrational spectra of uranyl nitrate, acetate, and sulfate solutions permits the conclusion that the light absorption in the 200 to 330 nm region is caused essentially by the excitation of the electron clouds of the ligands, and in the 330 to 500 nm regions by transitions to four excited electronic states of the uranyl group. A classification is proposed for the excited electron states of this group, based on a D_{6h} symmetry group representation. (auth)

25337 ABSOLUTE ABSORPTION INTENSITIES AND OPTICAL CONSTANTS OF LIGHT (H_2O) AND HEAVY (D_2O) WATER IN THE SPECTRAL REGION 4000 TO 1000 cm^{-1}. Zolotarev, V. M. Opt. Spectrosc. (USSR) (Engl. Transl.), 23: 442-4(Nov. 1967).

Translated from Opt. Spektrosk., 23: 816-20(Nov. 1967).

The optical constants n_2 and k_2 were measured for H_2O and D_2O. The absolute intensities of the bands $\nu_1 H_2O$ and D_2O were found to be 90×10^3 and 60×10^3 l/mole/cm^2, respectively. The results of the measurements of k_{2max} of the H_2O bands are tabulated and compared with previously published values. The measured values for both n_2 and k_2 for H_2O and D_2O are presented graphically, and some attempt is made to explain the differences in the measurements for the two systems. (B.L.M.)

25338 INVESTIGATION OF URANYL ION COMPLEXES IN CONCENTRATED CHLORIDE, PERCHLORATE, AND NITRATE SOLUTIONS. Celeda, J.; Jedinakova, V.; Smirous, F. (Inst. of Chemical Tech., Prague). Chem. Zvesti, 22: 93-101(1968). (In Czech).

The method of apparent molar volumes was used to study the formation of UO_2^{2+} complexes in ClO_4^-, Cl^-, and NO_3^- media. In all media, the UO_2^{2+} ions were found to bond four other ligands in addition to the two O atoms in the first coordination sphere. In ClO_4^- solutions electrophoretic measurements indicated that no inner sphere perchlorato-complexes nor electroneutral outer-sphere complexes were formed. In NO_3^- solutions, both NO_3^- ligands enter the inner coordination sphere of the UO_2^{2+} ion and a complex $[UO_2(H_2O)_2(NO_3)_2]$ is formed. No significant association of further NO_3^- anions in the outer sphere takes place. In Cl^- solutions at concentrations above 1 M, a monochlorotriaquodioxouranic inner-sphere complex was found to form with the association of another Cl^- in the outer sphere. At concentrations above 7 M, a negatively charged particle is formed with another Cl^- in the outer coordination sphere. (B.L.M.)

25339 THE HEAT CAPACITY ANOMALY IN PHENANTHRENE; EFFECTS OF DEUTERATION, PURIFICATION, AND DISSOLUTION. Ringel, Herbert; Damask, A. C.; Arndt, R. A. (Brookhaven National Lab., Upton, N. Y.). Mol. Cryst., 3: 145-7(Aug. 1967).

The heat capacity anomaly of 380 cal/mole in phenanthrene around 70°C was studied under various conditions, including deuteration. Deuterated phenanthrene (99.4 atom % D), which was recrystallized from ethanol, showed an anomaly of 355 cal/mole. Zone refining (20 passes) in 2-mm pyrex tubing with ½ atm of purified N_2 caused the anomaly to increase to 423 cal/mole. Pure phenanthrene with an anomaly of 380 cal/mole was purified by chromatographic columns and vacuum sublimation

as well as by zone refining. After efforts to duplicate the processes were performed on the deuterated material, the anomaly of as-received phenanthrene was found to be 310 cal/mole. Thus, omission of the chromatographic and sublimation steps caused about 20% reduction of the heat capacity anomaly. Evidently the heat capacity anomaly in deuterated phenanthrene was larger than that in the nondeuterated material and its magnitude was probably larger than the 423 cal/mole for the partially purified sample. That the purification steps performed had considerable value was demonstrated by measuring the anomaly in the as-received phenanthrene. It was 150 cal/mole. No anomaly was observed in xylene solutions, indicating that the anomaly arises from the crystalline state of the molecule. (BBB)

25340 THE BROENSTED α AND ISOTOPE EFFECTS FOR VINYL ETHER HYDROLYSIS. Kreevoy, Maurice M.; Eliason, Robert (Univ. of Minnesota, Minneapolis). J. Phys. Chem., 72: 1313-16(Apr. 1968).

Like other reactions in which proton transfer is rate determining, ethyl vinyl ether hydrolysis was shown to obey the Broensted catalysis law with a variety of carboxylic acids, but acids of other structure gave rates substantially varying from those predicted by the carboxylic acid correlation. The value of α for carboxylic acids is 0.66. The over-all solvent isotope effect, k_H/k_D, was 3.2 ± 0.1. The competitive isotope effect, $\varkappa_H/\varkappa_D$, was 7.0 ± 0.1. If proton transfer was directly from H_3O^+ to the substrate, these led to a primary isotope effect, $(k_H/k_D)_I$, of 4.8 and a secondary solvent isotope effect, $(k_H/k_D)_{II}$, of 0.66. From the latter an isotopic α, α_1, of 0.56 was obtained. Competitive tritium isotope effects were measured and the Swain–Schaad relations obeyed. The reaction coordinate seems to be largely proton translation. (auth)

25341 KINETICS OF THE ISOTOPIC EXCHANGE BETWEEN o-IODOHIPPURIC ACID AND IODIDES IN ETHANOL SOLUTION. Marcopoulos, Christos A. (Democritus Nuclear Research Center, Athens). Radiochim. Acta, 8: 170-2(Dec. 1967).

Isotopic exchange between o-iodo-hippuric acid (hippuran) and potassium iodide was followed in ethanol solution using ^{131}I as tracer, at various temperatures and over a wide range of concentrations. To separate the organic from the inorganic compound an ion-exchange technique through a resin column was adopted and to follow the increasing activity of the hippuran a scintillation counter technique was applied. The reaction was found to follow a total first order kinetics. Specific rates and the Arrhenius parameters were calculated. (auth)

25342 VACUUM DISTILLATION TECHNIQUES FOR RECOVERY OF ALKALI-METAL REACTION PRODUCTS. Gahn, Randall F. (Lewis Research Center, Cleveland). Anal. Chem., 40: 996-8(May 1968).

A procedure for the isolation and recovery of alkali metal reaction products is described. The procedure was designed to minimize reaction product contamination by carrying out all operations in high-vacuum or inert gas atmospheres. A total of 70 alkali metal reaction product separations was made including reaction products from the K–Ta–O, K–Nb–O, Li–Ta–O, Li–Nb–O, Li–V–O, and P–O systems. The K–Ta–O reaction product recovery and K–O reaction product recovery are discussed in detail. (D.H.M.)

25343 CHRONOPOTENTIOMETRIC STUDY OF THE URANYL SPECIES IN MOLTEN LiCl–KCl EUTECTIC. Caligara, F.; Martinot, L.; Duyckaerts, G. (Univ. of Liege). Inorg. Nucl. Chem. Lett., 4: 169-74(Apr. 1968).

It was observed that UO_2Cl_2 decomposed at 450°C in the eutectic, and that a considerable amount of UO_2Cl was formed at 580°C within 2 hours, even when operating in a closed vessel. This may be exploited to determine the diffusion coefficients of both species by following the times of the first and second steps of the electrochemical reduction $UO_2Cl_2 \rightleftharpoons UO_2Cl + \frac{1}{2} Cl_2$ and $UO_2Cl \rightleftharpoons UO_2 + \frac{1}{2} Cl_2$. The experimental set-up is described, typical results are shown, and the results discussed. (UK)

25344 MASS SPECTROMETRY OF METAL CHELATES. III. FURTHER STUDIES ON METAL OXINATES. Major, J. R.; Reade, M. J. A.; Stephen, W. I. (Univ. of Birmingham, Eng.). Talanta, 15: 373-8(Apr. 1968).

The mass spectra of the oxinates of gallium, dysprosium, beryllium, samarium, cadmium, neodymium, indium, bismuth, lanthanum, yttrium, and gadolinium were recorded. The results were correlated with the structures proposed in the literature. The integrated ion current method was applied to determine submicrogram quantities of some of these compounds. Oxinates insoluble in organic solvents, or undergoing reaction on solution, were precipitated directly in the evaporation probe. The factors which determine the suitability of metal chelates for the estimation of metals by this method are discussed, together with the instrumental factors which determine the ultimate sensitivity. (auth) (UK)

25345 FORMATION AND REACTIVITY OF NITRIDES. I. REVIEW AND INTRODUCTION. Glasson, D. R.; Jayaweera, S. A. A. (Coll. of Tech., Plymouth, Eng.). J. Appl. Chem. (London), 18: 65-77(Mar. 1968).

Methods of nitride production are summarized and their thermodynamics surveyed. Crystal structures and types of bonding in binary and ternary nitride compounds are classified and discussed. Kinetics of nitride formation are related to structural changes in the materials, which control diffusion of metals and nitrogen and cause nitride scaling. Metal nitridation with ammonia and nitride formation during ammonia synthesis are discussed. Information so far available on the sintering of nitrides, and its effect on their chemical reactivity, is reviewed. This effect is influenced by additives or impurities such as oxides, formed by partial nitride hydrolysis and oxidation. Sintering and hot pressing increase the resistance of nitrides to hydrolysis and oxidation, so that they become more suitable for use as refractories. Corrosion resistance of nitride layers on metal surfaces is often impaired by poor scaling resistance in air or oxygen at comparatively low temperatures. The kinetics and products of oxidation of nitrides so far studied, notably AlN, TiN and UN, depend mainly on the intrinsic reactivity of the material and the available surface at which oxidation can occur. Subsequent work will be concerned with changes in phase composition, surface area and crystallite and aggregate sizes, and their correlation with production, sintering, hydrolysis and oxidation conditions for single and mixed nitrides. Suitable experimental techniques are summarized. 243 references. (auth) (UK)

25346 PHOTO-OXIDATION AND REDUCTION OF AROMATIC MOLECULES AT SURFACES. Kallmann, H.; Krasnansky, V. J. (New York Univ., N. Y.). pp 887-95 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

A model developed for interpretation of the photooxidation of organic compounds is described. Experiments with liquids, solutions and polar solvents are also described. (M.C.G.)

25347 CONCURRENT ION-MOLECULE REACTIONS. PART 4. REACTIONS IN MIXTURES OF AMMONIA AND WATER WITH DEUTERIUM AND METHANE. Harrison, A. G.; Thynne, J. C. J. (Univ. of Toronto). Trans. Faraday Soc., 64: 945-53(Apr. 1968).

These reactions were studied using the ratio plot method. The following reactions were detected in mixtures with ammonia and their cross sections and rate constants determined at 10.5 cm^{-1} repeller field strength: $NH_3^+ + NH_3 \rightarrow NH_4^+ + NH_2$; $NH_3^+ + D_2 \rightarrow NH_3D^+ + D$; $D_2^+ + NH_3 \rightarrow NH_3D^+ + D$; $D_2^+ + NH_3 \rightarrow D_2H^+ + NH_2$; $CD_4^+ + NH_3 \rightarrow CD_4H^+ + NH_2$; $CD_4^+ + CD_4 \rightarrow CD_5^+ + CD_3$. In mixtures of deuterium and methane with water the following reactions were studied and cross sections and rate constants determined: $H_2O^+ + D_2 \rightarrow H_2OD^+ + D$; $D_2^+ + H_2O \rightarrow H_2OD^+ + D$; $D_2^+ + D_2 \rightarrow D_3^+ + D$. $H_2O^+ + CH_4 \rightarrow H_3O^+ + CH_3$; $CH_4^+ + H_2O \rightarrow H_3O^+ + CH_3$. These results were compared with those reported for other mixtures, and with the theoretical results calculated on the basis of the ion-induced dipole model. (auth) (UK)

25348 THERMAL CONDUCTIVITY OF 46 GASES AT ATMOSPHERIC PRESSURE. Liley, P. E. (Purdue Univ., West Lafayette, Ind.). pp 323-49 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

Available information on the thermal conductivity of 46 gases at atmospheric pressure is reviewed and most probable values recommended. Departure plots are given for sixteen substances of wide interest showing the accord between the different information and the recommended values. 257 references are cited. Some brief comments are made on the state of the art and on additional information sources, partly contained in 9 additional references. Specifically, the substances considered are acetone, acetylene, air, ammonia, argon, benzene, boron trifluoride, bromine, n-butane, carbon dioxide, carbon monoxide, carbon tetrachloride, chlorine, deuterium, ethane, ethyl alcohol, ethyl ether, ethylene, fluorine, Freon-11, Freon-12, Freon-13, Freon-21, Freon-22, Freon-113, helium, heptane, hexane, hydrogen, hydrogen chloride, iso-butane, krypton, methane, methyl alcohol, methyl chloride, neon, nitric oxide, nitrogen, nitrogen peroxide, nitrous oxide, oxygen, pentane, propane, sulfur dioxide, toluene, and xenon. (auth)

25349 DIFFUSION EXPERIMENTS WITH SIMPLE GASES IN THE CRITICAL REGION. De Paz, M. (Univ., Genoa). pp 91-5 of Proceedings of the Fourth Symposium on Thermophysical

Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

Measurements of self-diffusion in dense argon by means of a dynamic method, and the mixtures of argon with neon and deuterium are described. Experiments in the critical region were performed with temperature control to within $\pm 10^{-3}$K. The density was measured by two independent methods with an accuracy of ±1%. No striking critical effects were observed in diffusion. The changes in the transport mechanism on moving from the gas region to the liquid region were examined. (auth)

25350 OPERATIONAL PRINCIPLE AND CONSTRUCTION OF AN OXYGEN ELECTRODE WITH OXIDE-ION CONDUCTING $Th_{0.8}Y_{0.2}O_{1.9}$ SOLID ELECTROLYTE MEMBRANE FOR POTENTIOMETRIC MEASUREMENTS IN SALT MELTS. Eichler, B.; Naumann, D.; Ullmann, H. (Deutsche Akademie der Wissenschaften zu Berlin). Z. Phys. Chem. (Leipzig), 236: 372-7 (1967). (In German).

An oxygen electrode was constructed using a ThO_2 ceramic tube, sealed at one end. The ceramic tube was prepared by the dross casting method and was sintered gas-tight at 2150°C. In order to avoid contamination of the ceramic, the initial material was pulverized in a polyethylene vessel. The reproducibility of the potential measurements was tested using the Ag/AgCl reference electrode, in the potentiometric titration of Na_2O with $Na_4P_2O_7$. The results showed that the reproducibility of the electrode potential improved with increasing temperature. (J.S.R.)

25351 CHEMISTRY OF RARE EARTHS. Chem. Process. (London)., 14: 22-6(Apr. 1968).

As a result of specialized studies of lanthanide oxide and carbonate production at Los Alamos Scientific Laboratory, new knowledge of rare earth chemistry as a whole was gained. Further potential industrial applications for these elements was also indicated. (auth) (UK)

25352 KINETIC ISOTOPE EFFECT IN THE FORMATION OF ANTHRAQUINONE. Noyce, Donald S.; Kittle, Paul A.; Banitt, Elden H. (Univ. of California, Berkeley). J. Org. Chem., 33: 1500-3(Apr. 1968).

The rate of formation of anthraquinone from 2-(2'-deuteriobenzoyl)benzoic acid is less than the rate for the protium analog, k_H/k_D varying from 1.28 in 97% sulfuric acid to 1.20 in 104% sulfuric acid. The product anthraquinone retains from 56 to 62% of one deuterium. The mechanistic implications of these results are discussed. (auth)

25353 KINETICS OF RADICAL POLYMERIZATION. XXII. MECHANISM OF THE REACTION BETWEEN PHENOLS AND POLYVINYL ACETATE RADICALS. Simonyi, M.; Tudos, F.; Holly, S.; Pospisil, J. (Central Research Inst. for Chemistry, Budapest). Eur. Polym. J., 3: 559-72(1967).

Hydrogen–deuterium isotopic exchange was studied to investigate the mechanism of radical reactions of polyvinyl acetate involving phenols, particularly hydroquinone (HQ) and pyrocatechol (PC). After filtering the monomer, vinyl acetate (VAc), 2 ml D_2O was added to 500 ml VAc and repeatedly distilled; 300 ml of the main fraction was collected and a further 0.5 ml D_2O added. Prepolymerization was started immediately. It was found in control experiments that H_2O or D_2O used in such quantities did not influence the rate of polymerization. For producing the deuterated derivatives of HQ and PC the saturated heavy water solutions of 1 g HQ or PC were repeatedly evaporated. The deuterated products were used in kinetic investigations carried out at 50°. The rate-determining step in the reactions between phenols and polyvinyl acetate radicals is H transfer from the phenols. The experimental evidence for this was the very slight reactivity of the alkyl and acyl derivatives, and the kinetic isotope effect. Since a rapid isotopic exchange occurred between deuterated phenols and traces of moisture present in the medium, the isotope effect was measurable only by saturation of the monomer with heavy water. Electron-repelling substituents in the phenols increased the kinetic isotope effect. The differences between the reactivities and isotope effects of HQ and PC were interpreted by assuming a direct interaction between the oxygen atoms of the ortho isomer. (BBB)

25354 THE PYROLYSIS OF THE EPIMERIC d_0- AND 2-d_1-2-METHYLCYCLOHEXYL-S-METHYL XANTHATES AND ACETATES. Briggs, W. Scott; Djerassi, Carl (Stanford Univ., Calif.). J. Org. Chem., 33: 1625-9(Apr. 1968).

The Chugaev xanthate and ester pyrolysis reactions were examined in the epimeric cis- and trans-2-methylcyclohexyl-S-methyl xanthates and acetates by comparison of results obtained for the unlabeled and 2-d_1-labeled substrates. While the olefinic products obtained from the pyrolysis of the trans-2-d_1 xanthate and acetate exhibited isotopic contents consistent with those to be expected through operation of a homogeneous cis-cyclic elimination process, the products from the cis-2-d_1 xanthate and acetate did not. In the latter compounds, kinetic deuterium isotope effects (k_D/k_H) were calculated and from these values and isotopic content data for the 1-methyl-1-cyclohexene fraction derived. Possible ionic mechanisms were proposed for the net trans-elimination process in these compounds. (auth)

25355 MOESSBAUER SPECTROMETRY. DeVoe, J. R.; Spijkerman, J. J. (National Bureau of Standards, Washington, D. C.). Anal. Chem., 40: 472R-89R(Apr. 1968).

A review of the applications of Moessbauer spectrometry to chemistry is presented in tabular form. The following topics are discussed: spectrophotometric technique, including absorbers, detectors, preparation of sources, Doppler drives, cryostats, magnetic fields, Moessbauer nuclear fluorescence scattering, precision and accuracy, use of standards in Moessbauer spectrometry, and spectrum resolution technique; and analysis of a Moessbauer spectrum. (505 references) (J.G.B.)

25356 X-RAY DIFFRACTION. Merritt, Lynne L. Jr.; Streib, William E. (Indiana Univ., Bloomington). Anal. Chem., 40: 429R-39R(Apr. 1968).

General, analytical, industrial, and structural applications of x-ray diffraction are outlined. Developments during 1966–67 are included. (495 references) (J.G.B.)

25357 MAGNETIC SUSCEPTIBILITY. ASPECTS OF INSTRUMENTATION AND APPLICATIONS TO CHEMISTRY AND SOLID STATE SCIENCE. Mulay, L. N.; Mulay, Indumati L. (Pennsylvania State Univ., University Park). Anal. Chem., 40: 440R-55R(Apr. 1968).

Topics included in a review of significant 1966–67 magnetics literature are: general literature; instrumentation, including general aspects of force measurements; and applications to chemistry and solid state science. (152 references) (J.G.B.)

25358 THERMAL ANALYSIS. Murphy, C. B. (Xerox Corp., Webster, N. Y.). Anal. Chem., 40: 380R-91R(Apr. 1968).

The following topics are reviewed: thermogravimetric analysis, differential thermal analysis, dilatometry, electrothermal analysis, microscopy, pyrolysis, and miscellaneous methods. (460 references) (J.G.B.)

25359 STATISTICAL METHODS IN CHEMISTRY. Hill, Hubert M.; Brown, Robert H. (Tennessee Eastman Co., Kingsport). Anal. Chem., 40: 376R-80R(Apr. 1968).

Applications of statistics in chemistry and chemical engineering are reviewed. The following topics are treated in a discussion of statistical and quality control methods: statistical analysis, experimental design, building and testing models, and statistical quality control. Examples of statistical applications for various analytical methods, interlaboratory studies, and chemical and physical processes are given. (129 references) (J.G.B.)

25360 RAMAN SPECTROMETRY. Hester, Ronald E. (Univ. of York, Eng.). Anal. Chem., 40: 320R-30R(Apr. 1968).

A review on significant literature concerned with Raman spectrometry and appearing during 1966–67 is presented. Topics discussed pertaining to developments in the theory and practice of Raman spectrometry include: intensities, band shapes, and resonance Raman effect; stimulated Raman scattering; crystals; electronic Raman spectra; Raman scattering of x rays, electron beams, and microwaves; and techniques. Applications of Raman spectrometry to studies of inorganic and organic compounds are discussed. (363 references) (J.G.B.)

25361 ELECTRON PARAMAGNETIC RESONANCE. Eargle, Dolan H. Jr. (Univ. of Illinois, Chicago). Anal. Chem., 40: 303R-20R(Apr. 1968).

Literature on electron paramagnetic resonance is reviewed for the period August, 1965 to July 1967. Classification is by compound type unless theoretical considerations are of primary importance. Categories include: books; reviews; theoretical; inorganic and metal-organic systems; organic compounds and components; and experimental techniques. (928 references) (J.G.B.)

25362 ELECTRON MICROSCOPY. Fisher, R. M. (United States Steel Corp., Monroeville, Pa.); Lally, J. S.; Greider, Marie H. Anal. Chem., 40: 554R-60R(Apr. 1968).

A limited summary of the developments in electron microscopy during 1966–67 is presented. Topics discussed are: commercial instruments and accessories, laboratory instrumentation, high-voltage microscopy, image contrast, novel techniques for crystalline materials, and applications in biology. (127 references) (J.G.B.)

25363 NUCLEAR MAGNETIC RESONANCE SPECTROMETRY. Heeschen, Jerry P. (Dow Chemical Co., Midland, Mich.). Anal. Chem., 40: 560R-608R(Apr. 1968).

Material published from July, 1965 through June, 1967 is reviewed. An attempt is made to summarize or refer to developments pertinent to the broad understanding and practice of NMR spectroscopy. Topics discussed are: instrumentation; obtention of spectral parameters; relaxation; chemical shift; indirect spin-spin coupling; kinetic processes; conformation and configuration; association phenomena, and other related topics. (2227 references) (J.G.B.)

25364 PHOTOCHEMISTRY OF GASEOUS ACETONE. Shaw, Henry. New Brunswick, N. J., Rutgers-The State Univ., 1967. 198p.

Thesis.

The photochemistry of gaseous acetone, A, was investigated over a 2000-fold pressure range at 121, 216, and 298°C. The quantum yield of CO was 1.0 at 216 and 298°C and 0.86 at 121°C. At the highest pressures (ca. 200 torr) a slight decrease in quantum yield was apparent. A mechanism was determined which accounts for the quantum yields of methane Φ_M, ethane, Φ_E, and methyl ethyl ketone, Φ_{MEK}, in the high-pressure photolysis. Methyl ethyl ketone was shown to be produced by a disproportionation reaction of two acetonyl radicals, $2CH_3COCH_2 \xrightarrow{24} CH_3COC_2H_5 + CH_2CO$. Methane was produced by $CH_3 + A \xrightarrow{14} CH_4 + CH_2COCH_3$, and ethane was produced by the dimerization of methyl radicals $2CH_3 \xrightarrow{4} C_2H_6$. The high-pressure limiting quantum yields were $\Phi_{MEK} = k_{24}/K_{23} + k_{24}$ where k_{23} is the rate constant for $2CH_3COCH_2 \xrightarrow{23} (CH_3COCH_2)_2$, $\Phi_M = 2$ and $\Phi_E = 4k_4I_a/k_{14}[A]$. The intensity dependence of Φ_E was checked experimentally. Taking energy transfer considerations into account excellent agreement was obtained with published data for k_{14}/k_4. By correcting literature values of k_4 the high-pressure limit was found to be $k_{4\infty} = (2.0 \pm 0.15)10^9\ T^{\frac{1}{2}}$ l mole^{-1} sec^{-1}. This yields $k_2 = (3.3 \pm 1.5)10^8 \exp[(-9440 \pm 350)/RT]$ l mole^{-1} sec^{-1}. The high pressure mechanism did not hold at pressures less than 20 torr. Methane was apparently produced by reactions other than step 14 as was evident by $\Phi_M \rightarrow 1.0$ as pressure goes to zero. The Φ_E curves showed a trend that could be reconciled with an ethane consumption step. The methane-producing steps and ethane-removal steps were not identified. An empirical factor was determined, which was used to correct the low-pressure data in order to evaluate the energy transfer parameters for vibrationally excited ethane. A mechanism, involving thermally energized methyl radicals, was proposed to account for the additional methane, and for ethane depletion. The relaxation process of vibrationally excited ethane is explained in terms of RRKM unimolecular theory. The values of the non-equilibrium unimolecular rate constant, k_b, for $C_2H_6^* \xrightarrow{b} 2CH_3$ agreed with theoretical predictions at low pressures but deviated significantly at high pressures. The reduced dimerization rate constant $k_4/k_{4\infty}$ differed from theoretical values over the whole pressure range. Better agreement between theory and experiment was obtained when the vibrationally excited ethane was assumed to contain energy in excess of that predicted on thermodynamic grounds. The excess energy could be due to "hot" methyl radicals. The energy transfer efficiency of He and Xe for the deactivation of vibrationally excited ethane was determined at 216°C. On a pressure basis He and Xe were equally inefficient since it required 13 times the pressure of acetone to deactivate excited ethane to the point where the rate of stabilization was equal to the rate of decomposition. On a collisional basis 6 collisions with He or 11 with Xe were needed based on the strong collision formulation for acetone. The energy removed per collision was approximately 0.5 Kcal mole^{-1} for the noble gases in agreement with literature values for other systems. Mixtures of fully deuterated and fully protiated acetone were photolyzed at 327°C. The rates of methane production were $CHD_3 > CH_4 > CD_4 > CDH_3 > CD_2H_2$. No isotope exchange reactions were found in dark runs at 327°C. (Disser. Abstr.)

25365 ACTIVATION ENERGIES OF ELEMENTARY REACTIONS. Penzhorn, Ralf-Dieter Herbst. Washington, D. C., Catholic Univ. of America, 1967. 108p.

Thesis.

The rate of addition of thermal and exited H atoms to ethylene and deuterated ethylene was measured. This was done by competing the reaction $H + HI$ with $H + C_2H_4$. Since the rate of the first of these reactions, which was used as a standard, was questionable, the competition of $H + HI$ with $H + I_2$ was studied first. The H atoms were produced by photolysis of HI with 2537 Å light. Since these H atoms are "hot" they were moderated by the presence of a large excess of inert gas and the effect of I_2 on the rate of H_2 formation measured. HI was then photolysed in the presence of a large excess of inert gas and the effect of C_2H_4 on the rate of formation of H_2 studied. These experiments permitted a better understanding of the mechanism of the process and allowed the kinetic parameters for the reactions $H + HI \rightarrow H_2 + I$ and $H + C_2H_4 \rightarrow C_2H_5$ to be measured relative to the rate of the reaction $H + I_2 \rightarrow HI + I$. The isotope effect was examined in detail for the $H + C_2D_4$ reaction by studying the HD/H_2 ratio as a function of the C_2H_4/HI ratio and the inert gas pressure. Experimental evidence strongly indicates that a "hot" ethyl radical, whose rate of decomposition is energy dependent, participates as an intermediate. Reactions of hot H atoms were investigated in the absence of inert gas. The ratios of the hot rate constants for the reactions $H + HI, H + C_2H_4$ and $H + HI, H + I_2$ were found similar to the corresponding ratios of Arrhenius preexponential factors of the moderated reactions. (Disser. Abstr.)

25366 CHEMISTRY OF DISSOCIATED WATER VAPOR AND RELATED SYSTEMS. Venugopalan, M.; Jones, R. A. Interscience Monographs on Physical Chemistry. New York, John Wiley and Sons, Inc., 1968. 480p. $19.50.

Discussion is included under the following chapter titles: experimental methods; dissociation in electrical discharges at low pressures; thermal dissociation and dissociation by irradiation; reaction of hydrogen with oxygen; individual atoms, radicals, and their reactions; superoxides of hydrogen. Appendices on limitations of Wood-Bonhoeffer fast-flow systems and bond dissociation energies are included. Author, reaction, and subject indexes are also included. (J.G.B.)

25367 ATOMIC AND NUCLEAR CHEMISTRY. VOLUME I. ATOMIC THEORY AND STRUCTURE OF THE ATOM. Peacocke, T. A. H. Oxford, Pergamon Press. 1967. 156p. 25s.

Discussion is presented on: classical atomic theory; classification of the elements; atoms and electrons; atomic structure; development of wave mechanical model of the atom; and, determination of atomic weights. Miscellaneous questions and answers are included, together with some suggested experimental work. (UK)

25368 STUDIES OF THE SYNTHESIS, HYDROGEN–DEUTERIUM EXCHANGE, AND RACEMIZATION OF ASYMMETRIC SECONDARY PHOSPHINE OXIDES. Emmick, Thomas Lynn. Evanston, Ill., Northwestern Univ., 1967. 108p.

Thesis.

An investigation of the stereochemistry of asymmetric secondary phosphine oxides was undertaken. A procedure was developed for the synthesis of unsymmetrically substituted secondary oxides. On treating ethyl n-butylphosphinate and ethyl phenylphosphinate with the appropriate Grignard reagent benzyl-n-butyl-, n-butylphenyl-, n-butyl-p-chlorobenzyl-, benzylphenyl-, p-bromobenzylphenyl-, and 4-biphenylylphenylphosphine oxides were obtained. The secondary phosphine oxides were characterized by elemental analysis, infrared and proton magnetic resonance spectroscopy, and by oxidation to the corresponding phosphinic acids. The proton magnetic resonance study of the oxides and the phosphinate esters indicated a simple relation between the chemical shifts of the phosphorous-bonded hydrogen and the substituents attached to the phosphorus atom. It was also found that the 4-biphenylylphenyl- and benzylphenylphosphine oxides could be prepared by an alternate route, lithium aluminum hydride reduction of methyl 4-biphenylylphenylphosphinate and menthyl benzylphenylphosphinate, respectively. When (-)-menthyl (-)-benzylphenylphosphinate was reduced with lithium aluminum hydride, optically active benzylphenylphosphine oxide was obtained. Both dibenzyl- and benzylphenylphosphine oxides were found to undergo facile H–D exchange at the P–H position with methanol-d under neutral conditions. In the presence of hydrochloric acid and sodium methoxide the rate of exchange was as great, possibly greater, than in methanol-d alone. A tautomeric tricovalent form of the oxide, $\geq P-OH$, was proposed as an intermediate in the exchange reaction. (-)-Benzylphenylphosphine oxide was found to be optically stable in methanol; however, racemization was observed when hydrochloric or sulfuric acid was added. A pentacovalent intermediate resulting from the attack of a nucleophile at the P atom of the protonated form of the secondary oxide was proposed to explain the observed racemization. Racemization was also observed when an alcoholic solution of (-)-benzylphenylphosphine oxide was treated with sodium methoxide. Racemization in this case apparently proceeds by way of an anion formed by fission of the P–H bond. A comparison of the rates of base catalyzed racemization and nucleophilic addition to formaldehyde indicates that the optically active asymmetric anion has an appreciable lifetime in solution. (Disser. Abstr.)

25369 MECHANISMS OF THE THERMAL ISOTOPIC EXCHANGE REACTIONS BETWEEN ELEMENTARY IODINE AND IODONAPHTHALENES AND MECHANISM OF THE THERMAL ISOTOPIC EXCHANGE REACTION BETWEEN ELEMENTARY IODINE AND ISOBUTYL IODIDE. Nakashima, Masato. Eugene, Ore., Univ. of Oregon, 1967. 138p.

Thesis.

Thermal isotopic exchange reactions of α- and β-iodonaphthalenes with I_2 in solution in the approximate temperature range from 145 to 195°C were studied. ^{131}I was used as the tracer. The exchange runs showed only a small degree of side reactions, but, for β-iodonaphthalene, the cleansing and thermal treatments of Pyrex ampules used as the reaction vessel affected the rate. The rate law was first-order in I^- and one-half-order in I_2. A mechanism involving dissociation of I_2 molecules to iodine atom radicals and a subsequent rate determining step for the direct atomic displacement of iodine atom is proposed. In hexachlorobutadiene, for α- and β-iodonaphthalenes, the activation energies are 31.1 ± 1.1 and 31.3 ± 1.7 kcal/mole, and logarithms of the Arrhenius A (in units of $mole^{-1}s/sec$) are 10.9 ± 0.5 and 10.4 ± 0.8, respectively; in nitrobenzene, the activation energies are 29.4 ± 1.8 and 33.4 ± 8.3 kcal/mole, and the log A's are 10.1 ± 0.9 and 11.3 ± 4.1, respectively. The values of the log A's are practically equal to those for other iodides where mechanisms involve the similar atomic iodide displacement on the sp^2 carbons. The localization energies calculated by Hückel molecular orbital theory were used to correlate the reactivities of these and other aromatic iodides and of 1,2-diiodoethylenes. The results of this study suggest the complications of some sodium iodide-aromatic iodide exchange systems reported in the literature are due to the catalytic effect of molecular iodine that might be present in small concentrations. A brief study of the isotopic exchange kinetics of isobutyl iodide with molecular iodine in degassed hexachlorobutadiene at 160°C was made. Interpretation of the data was clouded by the large decomposition of the I^- during exchange runs. If the rate laws of the exchange and the decomposition are assumed to be first-order in the I^- and one-half-order in I_2, then the rate constants are about equal, and the rate constant for the exchange is approximately equal to that of n-propyl iodide at the same temperature. Mechanisms involving HI elimination and geminate recombination are discussed. (Disser. Abstr.)

25370 ORGANSOLS CONTAINING COLLOIDAL CARBON. Fitch, Frederick Troop; Braun, Ann Baker (to W. R. Grace and Co.). British Patent 1,106,333. Mar. 13, 1968. Priority date Sept. 24, 1964, United States.

A process is described for the preparation of an organosol containing colloidal C and a colloidal metal oxide. A mixture of a water-immiscible organic liquid, water, colloidal C, and colloidal metal oxide with at least some of the colloidal particles initially dispersed in the water and any remaining particles being dispersed in the organic liquid is prepared and then the water is removed from the dispersion. The colloidal particles have a coating of an organic carboxylic acid containing at least 5 C atoms. The process is particularly applicable to the preparation of organosols of zirconia, urania, and actinide oxide, or a rare earth metal oxide. (B.L.M.)

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Refer also to abstracts 25235, 25331, 25366, 25439, 25455, 25462, 25778, 26016, and 27089.

25371 (CONF-660706–, pp 195-9) PLASTICS AS A COMPANION AND A COMPETITOR OF WOOD. Stoler, Harry B. (Boise Cascade Corp., Yakima, Wash.).

The radiation curing of coated wood is discussed. The plastic coating is fused into the wood in this process using gamma or beta radiation. (M.C.G.)

25372 (COO–38-595) BIBLIOGRAPHY ON THE ELECTRON SPIN RESONANCE OF RADIATION PRODUCED RADICALS. (Notre Dame Univ., Ind. Radiation Lab.). Nov. 21, 1967. 93p. Dep. CFSTI.

The references are grouped under the following categories: liquid phase, hydrocarbons in solid phase, single crystals, other solid phase (and reviews), and polymers. The references within each category are arranged by year, up to 1967. An author index is included. (D.L.C.)

25373 (COO–1105-119) DESENSITIZATION OF LiF(TLD-100) DUE TO RADIATION DAMAGE. Doppke, K. P.; Cameron, J. R. (Wisconsin Univ., Madison. Dept. of Radiology). July 15, 1966. Contract AT(11-1)-1105. 12p. Dep. CFSTI.

Studies were made of the desensitization of LiF(TLD-100) powder exposed to ^{137}Cs gamma rays and 60-keV effective x rays using various annealing procedures. Data indicated that within experimental error there is no dose threshold for loss in sensitivity of LiF(TLD-100). At values greater than 25 krads there is less loss of sensitivity with higher LET radiation. However, initially the decrease in sensitivity occurred at a faster rate with 60-keV effective x rays. Repeated exposure of LiF to irradiation caused a greater loss of sensitivity after approximately 10^5 rads. (M.C.G.)

25374 (ORNL–4229, pp 22-49) BEHAVIOR OF FISSION PRODUCTS AND PROTACTINIUM IN MOLTEN FLUORIDES. (Oak Ridge National Lab., Tenn.).

Research progress is reported on molten-salt irradiation experiments, potentiometric studies of molybdenum in $LiF-BeF_2$, preparation and properties of molybdenum fluorides, mass-spectrometric studies of molybdenum fluorides, solubilities of SmF_3 and NdF_3 in molten $LiF-BeF_2$, reductive extraction of rare earths from molten fluorides into molten metals, metallic colloids in molten salts, reductive extraction of protactinium at tracer levels from molten fluorides into molten metals, and protactinium studies in the High-Alpha Molten-Salt Laboratory. (M.C.G.)

25375 (ORNL–4229, pp 183-7) EFFECTS OF RADIATION ON ORGANIC MATERIALS. (Oak Ridge National Lab., Tenn.).

Effects of radiation on organic materials are discussed under the following topics: effects of radiation on polymers, radioinduced reactions of hydrocarbons, addition reactions of furan derivatives, and development of radiation-resistant insulators. (M.C.G.)

25376 (PRNC–114) HOT-ATOM CHEMISTRY PROGRAM. Progress Summary Report No. 3, April 1967–March 1968. Wheeler, Owen H. (Puerto Rico Nuclear Center, [Mayaguez]). Contract AT(40-1)-1833. 10p. Dep. CFSTI.

Mechanisms of Szilard–Chalmers processes in organic compounds containing direct multiple bonds between the activated atom and carbon atoms of the organic radical are being studied. Studies with bicyclopentadienylosmium and bicyclopentadienylruthenium hydrides are nearly complete. The possibility of the recoil labeling with ^{128}I of liquid aromatics is being investigated. Samples of tetraphenylsilane and triphenylsilane were activated and processed. (M.C.G.)

25377 HYDROGEN FORMATION AND SUPEREXCITED STATES IN THE RADIOLYSIS OF LIQUID OLEFINS. Hatano, Yoshihiko (Tokyo Inst. of Tech.); Shida, Shoji; Inokuti, Mitio. J. Chem. Phys., 48: 940-1(Jan. 15, 1968).

A method is described for study of the properties of superexcited states. The method was applied to the study of superexcited states in the radiolysis of liquid olefins. Equations are given for calculation of the yield, g_s, per 100 eV energy absorbed, and calculated values are compared with experimental ones for the olefins studied. (B.L.M.)

25378 NEUTRON-INDUCED RADIOLYSIS OF LITHIUM NITRATE: LET AND PHASE CHANGE EFFECTS. Ward, T. G. Jr.; Axtmann, R. C.; Boyd, G. E. (Princeton Univ., N. J. Oak Ridge National Lab., Tenn.). Radiat. Res., 33: 456-64(1968).

Molecular O and NO_2^- yields were measured in the radiolysis of crystalline and molten $LiNO_3$ by the recoil particles from the $^6Li(n,\alpha)^3H$ reaction. The initial 100-eV yields of NO_2^-, $G_0(NO_2^-)$, increased from 0.22 for the solid to 5.5 for the melt. The generally lower radiolytic yields in $LiNO_3$ compared with those from other alkali metal nitrates are cited as evidence that radiolytic decomposition of NO_3^- is governed by cation-anion interaction. The ^6Li recoil particle yields in the melt exceed by about 50% those observed in ^{60}Co γ experiments, an LET effect attributed to more favorable conditions for O atom recombination. (auth)

25379 PRIMARY RADICAL YIELDS AND SOME RATE CONSTANTS IN HEAVY WATER. Fielden, E. M.; Hart, Edwin J. (Argonne National Lab., Ill.). Radiat. Res., 33: 426-36(1968).

Relative primary radical yields of hydrated electrons (e_d^-), D atoms, and OD radicals were determined by measuring the amount of e_d^- formed during a single 4-μ sec pulse of x rays. In neutral solution the e_d^- yield corresponds to $g(e_d^-)$, and at high pD's an additional amount is formed corresponding to g(D) by the reaction $D + OD^- = D_2O + e_d^-$. In the presence of dissolved deuterium the OD radical (with yield g(OD)) is converted to D by $OD + D_2 \rightarrow D_2O + D$ which, at high alkali concentrations, forms e_d^-. A pD range of 7 to 14.4 was covered. At pD above 12.5 the total primary radical yield, $g(e_d^-) + g(D) + g(OD)$, was constant, as was the total reducing yield, $g(e_d^-) + g(D)$. The total radical yield was measured at pD 13.5 with the permanganate-formate system as $G(e_d^- + D + OD) = 7.2$. From the relative yield determinations the separate radical yield values were calculated. A pD dependence on the $g(e_d^-)$ yield was observed. The rate constants of some reactions of the primary radicals with simple radiolytically important compounds were determined. (auth)

25380 GAMMA RADIOLYSIS OF MOLTEN LITHIUM NITRATE: DOSE-RATE EFFECTS. Ward, T. G. Jr.; Boyd, G. E.; Axtmann, R. C. (Princeton Univ., N. J. Oak Ridge National Lab., Tenn.). Radiat. Res., 33: 447-55(1968).

The radiolysis of molten $LiNO_3$ at 270°C by ^{60}Co γ rays was

studied as a function of absorbed dose and dose rate. The decomposition followed the stoichiometry $LiNO_3 \rightarrow LiNO_2 + \frac{1}{2} O_2$ with the initial 100-eV yield of NO_2^-, $G_0(NO_2^-) = 3.73 \pm 0.05$. At large doses NO_3^- approached steady-state concentrations that were a function of dose rate. This effect, surprising at low dose rates employed, is attributed to competitive chemical and radiation-enhanced back-reactions. (auth)

25381 PARAMAGNETIC STUDY OF IONIZED THIOUREA DERIVATIVES. Box, Harold C.; Budzinski, Edwin E.; Gorman, Thomas (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys., 48: 1748-51(Feb. 15, 1968).

The positive and negative ions of thiourea, allylthiourea, and dimethylthiourea produced by x irradiation at 4.2°K were studied by electron spin resonance (ESR) spectroscopy. The g tensors for the positive ion absorptions were measured in single crystals and correlated with the molecular structure of thiourea and allylthiourea. Some predictions concerning the crystal structure of dimethylthiourea were made from ESR data. The g shift associated with the negative ion is small compared with that of the positive ion. The spectra of the aforementioned planar molecules contrast sharply with the spectra obtained from irradiated tetramethylthiourea and dibenzylthiourea, which are nonplanar molecules. (auth)

25382 RADIOLYSIS OF MULTIPHASE SYSTEMS: HYDROCARBONS–WATER–OXYGEN. I. RADIATIVE OXIDATION OF HYDROCARBON INDIVIDUALS REPRESENTING VARIOUS GROUPS. Bryl-Sandelewska, Teresa; Nowak, Zofia; Kecki, Zbigniew; Minc, Stefan (Inst. of Nuclear Research, Warsaw). Przem. Chem., 46: 666-9(Nov. 1967). (In Polish).

Radiative oxidation of hexadecane, isooctane, decalin, and tetralin, in anhydrous state and in the system hydrocarbon–water, was carried out. Influence of the radiation, the dose absorbed, and the temperature on the yield of oxidation products were examined. Different effect of water in the process of radiative oxidation for individual hydrocarbons was established. Water decreased for tetralin, and slightly increased for decalin and isooctane the yield of radiative oxidation products. For hexadecane no effect of water was observed. On the basis of the reaction scheme presented, the influence of radiolysis products of water ought to be small, excepting the case when they initiated the formation of oxidation inhibitors, e.g. phenols. A hypothesis is presented that the previously observed positive effect of water phase in binary system does not consist in participation of water radiolysis products in chains of the oxidation reaction, but in washing out inhibitors from the organic phase. (auth)

25383 GAMMA-INDUCED POLYMERIZATION OF ACRYLONITRILE IN THE PRESENCE OF STANNOUS CHLORIDE AT -78°C. Kikuchi, Yasuo (Hiroshima Univ.). Kogyo Kagaku Zasshi, 71: 296-9(Feb. 1968). (In Japanese).

The γ-accelerated polymerization of acrylonitrile was reported at −78°C in various solvents containing $SnCl_2$. The effect of temperature on the polymerization was different in aqueous solutions from other solvents systems. In aqueous solution, when polymerization was carried out at −78°C the molecular weight of the polymers obtained decreased with increasing concentration of $SnCl_2$, while, at ordinary temperatures the molecular weight increased with increasing concentration of the salt. In other solvents, the result was reverse, i.e., the molecular weight increased at low temperatures and decreased at ordinary temperatures with increasing salt concentration. The presence of a certain kind of inhibitor hindered the radioinduced polymerization. From the results of infrared spectroscopy it was concluded that anionic polymerization proceeded in both dimethylformamide and aqueous systems. In other solvent systems such as benzene, methanol, petroleum ether, and acetone, a chain transfer to monomer was concluded. Crystallinity of the polymers was studied by x-ray diffraction measurements. (NSA of Japan)

25384 DEHYDROGENATION OF n-BUTANE ON NEUTRON-IRRADIATED OXIDE CATALYSTS. Spitsyn, Vikt. I.; Pirogov, G. N. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., No. 1, 84-6(1967). (In Russian).

The dehydrogenation of n-butane on catalysts having the composition: 10% V_2O_5 + 90% Al_2O_3, 10% MoO_3 + 90% Al_2O_3, and 10% WO_3 + 90% Al_2O_3, following their neutron irradiation in a nuclear reactor is described. In the presence of these catalysts, dehydrogenation of n-butane is also accompanied by cracking and isomerization. Slow-neutron irradiation of the aluminotungsten catalyst enhances the degree of transformation of n-butane, whereas similar irradiation of the other two catalysts does not affect their catalytic activity. This is apparently due to the fact that the aluminotungsten catalyst forms the isotopes ^{185}W and ^{187}W when irradiated. Hence, neutron irradiation affects catalytic activity only if it leads to the formation of a sufficiently radioactive isotope. This is apparently associated with the high temperature of this reaction. The defects produced by neutron bombardment are burned out at the dehydrogenation temperatures of n-butane and do not affect the activity of the catalysts. (JPRS)

25385 RADIOLYSIS OF AMMONIUM PERCHLORATE. Nevostruev, V. A.; Bugaenko, L. T.; Zakharov, Yu. A. (Tomsk Polytechnic Inst. Moscow State Univ.). Khim. Vys. Energ., 1: 406-7(1967). (In Russian).

Products of the transformation of the ClO_4^- ion in NH_4ClO_4 under the influence of 4.7-MeV protons were studied. Absorption spectra of the irradiated NH_4ClO_4 single crystal and its aqueous solution were taken. Curves of the accumulation of the radiolysis products of NH_4ClO_4 showed that at low doses all the curves were linear. At high doses, the ClO_3^- concentration reached a constant value, while the Cl^- concentration increased; this is explained by the thermal decomposition of ammonium chlorate, which is unstable at room temperature. The radiation yields of the radiolysis products Cl^-, Cl_2, ClO^-, and ClO_3^- were determined and found to be similar for the various products, except the yield of Cl^- ions, which for the action of protons is ~1.5 times lower than for γ radiolysis. (ATD)

25386 RADIATION AND OPTICAL STABILITY OF ANNEALED AND HARDENED GLASSES. Brekhovskikh, S. M.; Viktorova, Yu. N.; Landa, L. M. Steklo Keram., No. 6, 10-11(1967). (In Russian).

Integral transmission and visible absorption spectra of various γ-irradiated glasses, preliminary heat-treated or untreated, were studied to establish a correlation between thermal history and radiation-optical stability of the glasses. Experimental data showed that the optical characteristics of irradiated K-8 glass and GR rolled glass, both without cerium oxide addition, depended to a large extent on the thermal history of the glasses. A prolonged annealing of these glasses after irradiation with 10^7 RAD, caused some increase but air or liquid quenching caused a decrease in % transmission. Hence, radiation-optical stability of these glasses increased or decreased, presumably because of a decreased or increased number of structural defects. In contrast, the radiation-optical stability of the K-108 and K-208 glasses, of a composition similar to K-8 but with cerium oxide added, remained the same after various heat-treatments because of the predominance of the stabilizing effect of Ce ions over the effect of the structural changes. (ATD)

25387 SEPARATION AND CHARACTERIZATION OF THE VINYL SIDE CHAINS FROM GRAFTED POLYACRYLONITRIDE–COTTON COPOLYMERS. Morris, Nelle J.; Blouin, Florine A.; Arthur, Jett C. Jr. (Dept. of Agriculture, New Orleans). J. Appl. Polymer Sci., 12: 373-80(Feb. 1968).

A method of separation of polyvinyl side chains from grafted polyacrylonitrile–cotton copolymers was developed in order to study the effect of length of side chain on copolymer properties. The method consists of dispersion of the copolymer (1 g) containing 20% polyacrylonitrile in 75% aq. $ZnCl_2$ (100 ml), addition of 6N HCl (100 ml), heating for 1 hr at 100°C, and precipitation and purification of the resulting vinyl polymer. The effect of hydrolysis on the intrinsic viscosity, the N content, and the infrared absorption spectra of the polyacrylonitrile polymers was investigated. It was concluded that this method of separation of the grafted polymers permitted a comparison of samples grafted by various techniques. A series of grafted copolymers was hydrolyzed, and the molecular weights of the isolated products were determined by measurements of intrinsic viscosity. Copolymer samples prepared by a post-irradiation grafting technique had the longest polyacrylonitrile side chains (molecular weight, 1×10^6). Samples grafted by a simultaneous irradiation technique varied in side-chain length, depending on the monomer-solvent system used in preparation of the copolymer (molecular weight, $3 \times 10^4 - 5 \times 10^5$). Chemically initiated grafting to cotton resulted in a copolymer containing relatively short side chains (molecular weight, 9×10^4). (auth)

25388 RADIATION CHEMICAL STUDIES OF PROTEIN REACTIONS: RADIATION DOSE AND VISCOSITY CHANGE. Nisizawa, Mizuho (Defense Academy, Yokosuka, Japan). J. Appl. Polymer Sci., 12: 321-4(Feb. 1968).

Irradiation of protons by γ rays from a ^{60}Co source induced an activated state. An empirical equation for the viscosity change was obtained, and the phenomena were explained on the basis of the molecular mechanism. The general equation for the viscosity change is given by $\eta_{red} = (b + a \log R)(1 - e^{-kt})$, where η_{red} is the reduced viscosity of the solution, R is the γ radiation dose, and t is time. (auth)

25389 BEHAVIOUR OF RADIOIODINE RECOILS FORMED BY HIGH-ENERGY PROTON IRRADIATION OF MIXED CRYSTALS OF ALKALI HALIDES. Dema, I. (Inst. of Atomic Physics,

Bucharest); Zaitseva, Natalia G. Radiochim. Acta, 8: 175-6(Dec. 1967).

Mixed crystals of cesium chloride and alkali metal halides were irradiated with high-energy protons and the radioiodine recoils formed were studied. The yields of radioiodine in higher oxidation states in irradiated CsCl, CsCl–NaCl, CsCl–KCl, and CsCl–RbCl are given as a function of composition, proton dose, and post-irradiation treatments. The yield of higher valence states was higher in the mixed crystals than in pure cesium chloride. A decrease of radioiodine in higher valence states was observed on annealing, along with a corresponding decrease in color of the crystals. (M.C.G.)

25390 RECOIL REACTIONS IN CRYSTALLINE $C_5H_5Mn(CO_3)$. Zahn, Ursel (Technische Hochschule, Munich). Radiochim. Acta, 8: 177-8(Dec. 1967).

Isothermal, isochronal, and radiation annealing of neutron-irradiated $C_5H_5Mn(CO)_3$ was studied. The observed data and ^{56}Mn retentions in solid solutions of $C_5H_5Mn(CO)_3$ in benzene are discussed in an attempt to understand the secondary reactions leading to reformation of $C_5H_5{}^{56}Mn(CO)_3$. (M.C.G.)

25391 CHEMICAL EFFECTS IN THE NEUTRON ACTIVATION OF CYCLOPENTADIENYL DERIVATIVES OF ZIRCONIUM AND HAFNIUM. Wheeler, Owen H.; McClin, Maria Luisa (Puerto Rico Nuclear Center, Mayaguez). Radiochim. Acta, 8: 179-80(Dec. 1967).

The products formed on neutron activation of dicyclopentadienylzirconium dichloride and dicyclopentadienylhafnium dichloride were studied. About $^2/_3$ of the ^{97}Zr activity formed could be complexed with cupferron, with the other $^1/_3$ remaining as a nonextractable chloroform-soluble fraction. Only 2% of the activity consisted of a fraction that was extractable with hydrochloric acid but did not complex with cupferron. A large inorganic ^{181}Hf fraction (81%) was formed with only an insignificant amount of retention (0.5%). Comparison with previous date indicated that its chemical environment is critical in determining the retention of a hot metal atom. (M.C.G.)

25392 FORMATION OF POLYMERIC CARBON SUBOXIDE DURING GAMMA RADIOLYSIS OF LIQUID CARBON MONOXIDE AT 77°K. Briggs, J. P.; Clay, P. G. (Imperial Coll. of Science and Tech., London). Nature (London), 218: 355(Apr. 27, 1968).

It was suggested previously that the deposit formed during the γ-radiolysis of liquid Co was composed largely of solid carbon. Experimental data are reported indicating that the deposit is polymerised C_3O_2. Results also indicated that the reaction stoichiometry in the liquid phase at 77°K is the same as in the gas phase at 1 atm. and 295°K. Irradiations were carried out with a 17,000 Ci ^{60}Co source. Results are tabulated for total doses of 2.68 to 31 eV × 10^{20}, and dose rate 2.86 × 10^{17} eV/g/min. $G(CO_2)$ was estimated as 0.24 ± 0.01 mol/100 eV, which was about 25% higher than previously reported. Formation of the solid deposit may be caused by initial formation of monomeric C_3O_3 and its subsequent polymerisation by charge transfer from the primary ion CO^+. Formation of C_3O_2 monomer on addition of methane can be explained in terms of competition between C_3O_2 and CH_4 for CO^+, and it is unnecessary to invoke the formation of two different carbon atom species in the system. (UK)

25393 INTER- AND INTRAMOLECULAR ENERGY TRANSFER IN GAMMA RADIOLYSIS OF n-ALKYLBENZENES. Zeman, A.; Heusinger, H. (Technische Hochschule, Munich). Radiochim. Acta, 8: 149-58(Dec. 1967).

Hydrogen production in γ-irradiated n-alkylbenzenes (toluene to heptadecylbenzene), in isomeric n-alkyl-benzenes and n-alkylbenzenes-d_5 was investigated. Radicals formed at 77°K were identified by EPR spectroscopy and their G-values measured. A mechanism for the formation of hydrogen, based on ion-molecule reactions and hot-atom reactions, is proposed. The low $G(H_2)$ and G(R) values of the various n-alkylbenzenes indicated that the phenyl group protects the alkyl group, with respect to hydrogen and radical formation. Energy transfer was suggested to explain the results. A Markov chain approach showed that energy transfer from the aliphatic chain to the phenyl group is 13 times as probable as the dissociation of a C–H bond and the deactivation of the excited state involved. To separate inter- and intramolecular energy transfer, a similar investigation with alkane–benzene mixtures was carried out. The probability for energy transfer from the alkane chain to the benzene molecule was found to be 10 times as probable as the two other reactions. The results suggest that in n-alkylbenzenes both intermolecular transfer and intramolecular transfer take place with comparable efficiency. (auth)

25394 RADIOLYSIS OF BENZYL CHLORIDE IN THE LIQUID PHASE. Eberhardt, Manfred K. (Technische Hochschule, Munich). Radiochim. Acta, 8: 159-61(Dec. 1967).

The main dimeric products in the radiolysis of liquid benzyl chloride are: dibenzyl (G = 1.5), α-chlorodibenzyl (G = 1.1), meso-dichlorostilbene (G = 0.1), and dl-dichlorostilbene (G = 0.06). The results show that benzyl radicals are formed via two different mechanisms: dissociative electron attachment [G(Bz) = 2.9] and via an electronically excited state of benzyl chloride [G(Bz) = 1.2]. The α-chlorobenzyl radicals, which are not observed in organic glasses at 77°K, are formed in a secondary reaction of chlorine atoms with benzylchloride. (auth)

25395 ABSENCE OF THE SOLVENT INFLUENCE ON THE SZILARD–CHALMERS EFFECT IN POTASSIUM PERMANGANATE CRYSTALS. Cogneau, M. A.; Apers, D. J.; Capron, P. C. (Louvain Univ., Belgium). Radiochim. Acta, 8: 143-6(Dec. 1967).

The Szilard-Chalmers reaction in crystalline potassium permanganate was studied again, using ^{54}Mn as a tracer. After dissolution, the recoil atom was recovered only in the form of manganous ions. The retention was totally independent of the p_H of the solvent. Its value was about 22%. (auth)

25396 PHYSICAL INVESTIGATIONS ON CROSSLINKED HIGH POLYMERS. Heinze, Dieter (Badische Anilin- and Soda-Fabrik AG, Ludwigshafen am Rhein, Ger.). Chimia (Aarau), 22: 122-8(Mar. 15, 1968). (In German).

The effect of chemical crosslinks on the elastic properties and the position of the glass temperature is discussed by showing the example of natural rubber which was crosslinked by means of sulfur, peroxide, and radiation. Crosslinks reduce the crystallinity of partial crystalline high polymers and render the diffusion of low molecular substances more difficult. With polyester resins the diffusion rate is determinant for the curing. Apart from primary valence crosslinks physical crosslinkage can occur because of ordering effects or secondary valence forces. Entanglements, molecular associations, fillers, crystalline regions and amorphous blocks act within limited temperature ranges as physical crosslinks. In all these cases the temperature dependence of the dynamic mechanical moduli is a good criterion for configurational elasticity. (auth)

25397 HIGHER EXCITED STATES OF BENZENE AND TOLUENE EXCIMERS. Birks, J. B. (Univ. of Manchester, Eng.). Chem. Phys. Lett., 1: 625-6(Apr. 1968).

The transient absorption reported in the nanosecond pulse radiolysis of benzene and toluene is assigned to the $B_{1g} \rightarrow E_{1u}$ excimer transition. (auth)

25398 RECOIL PROCESSES OF ^{51}Cr IN K_2CrO_4 MIXED WITH ALKALI HALIDES. Milenkovic, S. M.; Veljkovic, S. R. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade. Univ. of Belgrade). Radiochim. Acta, 8: 146-8(Dec. 1967).

Hot-atom reactions of recoil ^{51}Cr in neutron-irradiated mixtures of K_2CrO_4 with KCl, KBr, or KI were studied. The presence of dissolved alkali halides caused a lower yield of radiochromium in the form of chromate ion. Thermal annealing of ^{51}Cr was enhanced in these crystals. (auth)

25399 INCREASE IN RADIORESISTANCE OF AROMATIC COMPOUNDS ON FORMATION OF MOLECULAR COMPLEXES. Katkova, N. M.; Ermolaev, V. K.; Bazhin, N. M. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Khim. Vys. Energ., No. 1, 87(1967). (In Russian).

The radiation yields of free radicals during radiolysis were measured and compared for quinone, hydroquinone, and the molecular combination of these substances, quinhydrone, at 120°K, with the aid of an EPR spectrometer directly during irradiation with 0.3-GeV electrons. The EPR spectra of the radicals of all the three substances represent isolated lines having widths of ~12 e for quinhydrone and 16 e for hydroquinone and quinone. The absolute values of the radiation yields of free radicals were ~0.1 1/100 eV for both quinone and hydroquinone and ~0.035 1/100 eV for quinhydrone, i.e., about one-third as high as for quinone and hydroquinone. These results do not make it possible to give an unambiguous explanation of the increase in radioresistance of quinhydrone as compared with the initial substances and hence a more detailed investigation of systems of this kind will be undertaken. (ATD)

25400 ENERGY SPECTRUM OF PRIMARY ACTIVATIONS IN THE ACTION OF IONIZING RADIATION. Platzman, R. L. (Univ. of Chicago). pp 20-42 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The temporal stages in the response of a medium to absorption of ionizing radiation are analyzed, and attention is focussed on initial events at the atomic level, i.e., the primary processes. Theoretical calculation of the yields of primary products requires

knowledge of two sorts, of degradation spectra and of excitation and ionization cross sections. Valuable information can also be obtained, and more simply, by use of the optical approximation, which requires knowledge of the complete oscillator-strength distribution of the molecule. The current status of both exact and approximate theories is appraised and results for some simple molecules are presented. Finally, the contributions of such studies to the understanding of radiation mechanisms are indicated. (auth)

25401 EVENTS FOLLOWING PRIMARY ACTIVATIONS. Boag, J. W. (Inst. of Cancer Research, Sutton, Eng.). pp 43-53 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Events that occur in the interval between energy absorption by a molecule and the subsequent formation of stable, or at least relatively long-lived product molecules, are discussed. Attention is focused on the time scale for degradation of energy transferred from charged particles to a molecular medium, the modes of disintegration of energy, and the fate of ionized molecules and the electrons that are ejected from them. Whether or not experimental methods, e.g., optical absorption spectroscopy, that have been used to identify the hydrated electron and other transient species are capable of being extended to the much shorter time scale necessary to permit observation of the short-lived excited molecules that are their precursors is discussed. (B.S.L.)

25402 ROLE OF MULTIPLE IONIZATION IN RADIATION ACTION. Ore, Aadne (Univ. of Oslo). pp 54-67 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The role of multiple ionization in radiation action is briefly discussed in relation to multiple ionization represented by adjacent ionizations and multiple ejection of loosely bound electrons essentially in a single act. A lengthy discussion of multiple ionization associated with an inner-shell ionization is presented. (B.S.L.)

25403 ENERGY DEPOSITION IN MATTER BY SLOW HEAVY PARTICLES. Kistemaker, J.; De Heer, F. J.; Sanders, J.; Snoek, C. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam). pp 68-95 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Platzman's suggestion to take into account rare events during the stopping process of a 100-keV proton moving through organic matter led to a reconsideration of the relative importance of elastic and inelastic processes in a collision cascade. In the range from 1 to 10 keV, protons lose about 5% of their energy in elastic recoils, but carbon, nitrogen, and oxygen atoms lose about 75%. A few cases of autoionizations due to heavy-particle collisions in the range from 10 to 100 keV are mentioned ($\sigma \approx 10^{-18}$ cm^2/atom). Recent results in hot-atom chemistry (10 to 5000 eV) suggest that many endothermic excitation and ionization processes have sometimes quite large probabilities ($\sigma \approx 10^{-16}$ cm^2/atom). These must be due to the crossing of electronic energy levels, during the collisions. The general insight in elastic collision cascades at particle energies below 1000 eV, together with the RNA-inactivation experiment by Jung and Zimmer, lead to the supposition that two rather independent and quite destructive collision cascades might take place, viz. a hydrogen and a (C,N,O) cascade. Inactivation cross sections of about 10^{-13} cm^2/molecule seem to be consistent with the size of collision cascades with internal energies of a few hundred eV. A radiation damage function was deduced, which underlines the necessity to know the size and the energy distribution function of a collision cascade. (auth)

25404 REACTIVE SPECIES FORMED IN THE RADIOLYSIS OF ORGANIC LIQUIDS. Freeman, Gordon R. (Univ. of Alberta, Edmonton). pp 113-30 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The mechanism of formation of free radicals in radiolysis systems is discussed. Disproportionation, combination, abstraction, and addition reactions of free radicals are considered. The formation and reactions of excited molecules, positive ions, electrons, and negative ions are described. (75 references). (M.C.G.)

25405 ESR STUDIES OF RADIATION-INDUCED UNSTABLE INTERMEDIATES IN INORGANIC SYSTEMS. Symons, M. C. R. (Univ. of Leicester, Eng.). pp 131-47 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The application of ESR techniques to the task of identifying species that remain trapped in inorganic materials after exposure to high-energy radiation, is reviewed. The principles involved in such identification are covered and some aspects of radiation damage in certain polymeric materials are discussed. Some implications regarding mechanism are drawn, with particular reference to the phenomenon of pairwise trapping of radicals. (auth)

25406 LOW-TEMPERATURE LUMINESCENCE OF GAMMA-IRRADIATED ORGANIC GLASSES. Bagdassarian, Kh. S.; Milutinskaya, R. I.; Kovalev, Yu. V. (Inst. of Physical Chemistry, Moscow). pp 148-60 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Solutions of aromatic compounds in hexene, which were preliminarily irradiated at 77°K, emitted a luminescence spectrum of the additives both at 77°K and during warming. The spectrum of naphthalene solution displayed fluorescence and phosphorescence bands of the monomeric molecules and fluorescence band of eximers. The spectral composition of the luminescence changed with conditions of irradiation and glow. The luminescence intensity at 77°K decreased with time according to the law: $I_0/I = 1 + kt$. In hexene during the time corresponding to a large decrease in luminescence intensity only a small percentage of the total emission was given off. The constant k depended very little on the nature of the additives. In a 1:1 hexene-isopropanol mixture the luminescence intensity of additives was much lower than that in pure hexene. During illumination of γ-irradiated solutions of TMPD in hexene at 77°K with infrared light, considerable increase in luminescence took place. The intensity of stimulated luminescence was proportional to the infrared light intensity. It was suggested that ions of the additives form stable pairs with the electrons or holes of the matrix. In addition, mobile (free) electrons and holes are present in low concentrations. On this basis the formal kinetics of isothermal luminescence is considered. (auth)

25407 RADIOLYSIS OF WATER VAPOUR. Anderson, A. R.; Winter, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). pp 167-78 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Work on the radiolysis of water vapor is reviewed and data are presented on the effects of temperature and pressure on observed yields. Pure water vapor is essentially stable to γ radiation with no further net radiolysis occurring after a low steady-state concentration of H_2 has built up. Several independent measurements demonstrated a small yield of nonscavengeable H_2 ($g(H_2) \sim 0.5$) but its origin was not established unequivocally. One of the major differences between water vapor and liquid water is attributed to a change in the charge neutralization of the hydronium ion. In liquid water charge neutralization always occurs by the reaction $H_3O^+(H_2O)_n + e^- \rightarrow H + (n+1)H_2O$, while in water vapor either this reaction or the following reaction can predominate depending on the conditions: $H_3O^+ + e^- \rightarrow 2H + OH$. Conditions that favor this reaction are high temperature and low pressures and the effects of varying these parameters are illustrated by measurements of H_2 yields from water vapor in the presence of various scavengers. These chemical data are related to physical identification of complex ions formed by electric discharges and by radiation in water vapor. In addition to changes in yields related to differences in the charge-neutralization reactions, however, there is an increased yield of H_2 accompanying a reduction in pressure. This enhancement is unaffected by the presence of an electron scavenger (CCl_4) and by changing the temperature so that one of the two reactions predominates. It is tentatively attributed to the unimolecular dissociation of an excited water molecule in competition with collisional deactivation. (auth)

25408 THE HYDRATED ELECTRON AND THE H ATOM IN THE RADIOLYSIS OF WATER. Thomas, J. K. (Argonne National Lab., Ill.). pp 179-94 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The properties of hydrated electrons formed in the pulse radiolysis of water are summarized. Rates of reactions of these electrons with metal ions and organic compounds are discussed. Hydrogen production in the radiolysis of water is also reported. (42 references). (M.C.G.)

25409 OXIDIZING SPECIES IN IRRADIATED WATER AND AQUEOUS SOLUTIONS. Adams, G. E. (Mount Vernon Hospital, Northwood, Eng.). pp 195-211 of Radiation Research.

Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Evidence from radiolytic investigations indicated that the hydroxyl radical is the major, if not the sole, oxidizing species produced in irradiated water except at extreme pH's. The types of oxidation reactions induced by the OH radical, the methods by which their kinetics are characterized, and factors influencing the susceptibility of molecular structures to oxidative free radical attack are discussed. (M.C.G.)

25410 THE EFFECT OF pH ON RADICAL AND MOLECULAR YIELDS IN THE RADIOLYSIS OF WATER. Buxton, G. V. (Univ. of Leeds, Eng.). pp 235-50 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The yields $G_{e^-_{aq}}$, G_H, G_{OH}, G_{H_2}, and $G_{H_2O_2}$ reported in the literature are reviewed. The majority of the data indicate that in the pH range 3 to 10 $G_{e^-_{aq}} = 2.3$, $G_H = 0.6$, $G_{OH} = 2.3$, $G_{H_2} = 0.4$, and $G_{H_2O_2} = 0.7$. As the pH is reduced from 3 to 0 G_R ($G_{e^-_{aq}} + G_H$) increases from 2.9 to 3.7 and there is a corresponding increase in G_{OH}, whereas G_{H_2} and $G_{H_2O_2}$ remain relatively unchanged. Above pH 10, H is converted to e^-_{aq} but G_R and G_{H_2} remain constant up to pH 14, $G_{H_2O_2}$ decreases from 0.7 to 0.4 and there is an equivalent increase in G_{OH}. Increasing solute concentration increases G_{-H_2O} when the product of k (radical + solute) and solute concentration exceeds 10^7 sec^{-1} if $k(e^-_{aq}, H \text{ or } OH + X) < k(e^-_{aq} \text{ or } H + OH)$, where X is the species produced by the reaction e^-_{aq}, H or OH + solute occurring in the spurs. Mechanisms proposed to account for increased radical yields at low and high pH are discussed. (auth)

25411 RADIATION CHEMISTRY OF FROZEN AQUEOUS SOLUTIONS. Schulte-Frohlinde, D. (Inst. fuer Strahlenchemie, Karlsruhe, Ger.). pp 251-62 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Information on the formation, identification, and reactivity of electrons and hydrogen atoms in frozen aqueous solutions is reviewed. The structure of the electron trap, reactions of electrons in ice, phase effects, and thermal disappearance of electrons and hydrogen atoms are discussed. (M.C.G.)

25412 RADIATION EFFECTS IN SOLID POLYMERS. Charlesby, A. (Royal Military College of Science, Swindon, Eng.). pp 265-73 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The chemical changes induced by radiation are basically similar in polymers and in low-molecular-weight organic materials. However physical changes can be very different, due to the high molecular weights involved. Most important are those due to crosslinking and degradation, which can give polymers very different properties, some of industrial importance. The theory of these reactions is not yet fully agreed. Both ionic and radical mechanisms are suggested. Many intervening steps are involved between initial energy absorption and final physicochemical effect. These can often be studied using such techniques as electron spin resonance and pulse radiolysis, and their understanding provides possible means of diverting the radioinduced effect into more beneficial channels. Factors that influence the radioinduced chemical changes include radical mobility and H migration. Analogies exist between these phenomena in polymers and in selected biological systems. Other radioinduced phenomena are thermoluminescence and conductivity. The former provides information on electron traps and on the nature of luminescent centers. (auth)

25413 INVESTIGATION OF HIGH-MOLECULAR COMPOUNDS BY MEANS OF THE RADIOTHERMOLUMINESCENCE METHOD. Buben, N. Ya.; Nikol'skii, V. G. (Inst. of Chemical Physics, Moscow). pp 288-96 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The luminescence observed on heating of organic compounds, preirradiated at a low temperature, permits investigation of molecular motion in organic compounds and of structural modifications related to crosslinking, plastification, mixing, etc. Radiothermoluminescence is accounted for by recombination of stabilized charges. The preirradiated sample shows several radiothermoluminescence peaks on heating. One of these, corresponding to β transition (initiation of molecular segmental motion), provides maximum information on high-molecular-weight compounds. Glow curves are presented for some butadiene rubbers. (M.C.G.)

25414 FREE RADICALS IN POLYISOBUTENE INDUCED BY ULTRAVIOLET IRRADIATION. Carstensen, P.; Ranby, B. (Royal Inst. of Tech., Stockholm). pp 297-315 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Three different samples of purified polyisobutene with molecular weights of 10^4, 2×10^5, and 1.2×10^6, were irradiated in vacuo at −196°C with ultraviolet light. The free radicals formed by this irradiation were studied by electron spin resonance. All three samples gave, when thoroughly purified, the same ESR spectra. The spectra obtained were interpreted as due to radicals formed by hydrogen and methyl group abstraction, while no main-chain scission radicals were indicated. The radicals that contributed to the ESR spectra were: main-chain $-\dot{C}H-$, side group $-CH_2$, methyl radicals $\cdot CH_3$, and their main-chain counterpart $-CH_2-\dot{C}(CH_3)-CH_2-$. Reaction mechanisms are proposed, which are in conformity with the findings from high-energy irradiation of this polymer that G(C = C)/G(fracture) > 1. In addition a doublet with a splitting of about 510 Gauss was observed in the ESR spectra, and ascribed to hydrogen atoms formed in the quartz glass sample tube or adsorbed on its surface. (auth)

25415 EFFECTS OF RADIATION ON POLYMER SOLUTIONS. Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 316-26 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

A general theory for intramolecular crosslinking or microgel formation and co-crosslinking of two polymers present in the same solution when polymers are irradiated in solution is presented. LET affects in dissolved polymers were studied by comparing the yields obtained with γ rays and He and Li particles from the reaction $^{10}B(n,\alpha)^7Li$. Pulse radiolysis of catalase is discussed. (M.C.G.)

25416 RADIATION-INDUCED OXIDATIVE DEGRADATION OF POLYOXYETHYLENEGLYCOL IN DILUTE SOLUTIONS IN CHLOROFORM AND IN WATER. Marchal, J. (CNRS, Strasbourg). pp 327-38 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Study of the initial steps of radioinduced oxidative degradation of dilute solutions of polyoxyethyleneglycol in chloroform and in water in the whole range of the pH showed that: macroradicals P˙ are formed by H atoms abstracted by Cl˙ and $RO_2^\cdot$ peroxyl radicals produced in the radiolysis of $CHCl_3$ and by OH˙ radicals in H_2O and that these macroradicals are oxidized to give $PO_2^\cdot$ peroxyl macroradicals, which can abstract H atoms from their own chain or from another macromolecule to give hydroperoxides POOH. They can also decompose by a unimolecular process to give chain scissions and fragments ended with an alkoxyl radical. Thus two chain reactions superimpose. Because of the relative stability of POOH groups at 25°C, only the chain reaction that involves $PO_2^\cdot$ decomposition is responsible for chain scissions in the initial part of the oxidative degradation of the polymer. Finally, the main characteristic feature of this oxidative degradation is that the chain termination reactions are performed by alkoxyl radicals and not by peroxyl radicals as usually assumed. (auth)

25417 RADIATION-INDUCED ISOMERIZATION OF DIENE POLYMERS. Golub, M. A. (Stanford Research Inst., Menlo Park, Calif.). pp 339-51 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Data pertaining to G-values for isomerization are summarized. While radioinduced isomerizations other than the cis-trans type were encountered in small molecules, the experience with macromolecules was apparently restricted to cis-trans isomerization, with one exception, cyclization. (auth)

25418 GRAFTING POLYMERIZATION BY GAMMA-RAYS. Rossi, C. (Univ., Genoa). pp 352-67 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Two techniques are considered simultaneous irradiation of

polymer and monomer and free irradiation of the polymer, followed by admission of monomer. It was concluded that in order to obtain graft polymerization below 60°C it is necessary to work with free radicals, that is, in the absence of oxygen. A quantitative approach to polymerization is shown to be possible on the basis of the assumptions that grafting velocity is almost completely controlled by the front penetration and not by polymerization rate and that the velocity of this penetration is proportional to radical concentration. The assumptions were evaluated by experimental studies. (M.C.G.)

25419 SOLID-STATE RADIATION CHEMISTRY OF SELECTED TRANSITION METAL CHELATES OF GLYCINE AND ALANINE. Gottschall, W. Carl Jr.; Tolbert, Bert M. (Univ. of Colorado, Boulder). Contract AT(11-1)-690. J. Phys. Chem., 72: 922-5(Mar. 1968). (COO-690-7).

The radiation chemistry of selected transition metal chelates of glycine and alanine was investigated in the solid state. Ammonia was released in greatest yield upon dissolution of the ^{137}Cs γ-irradiated samples and CO_2 was the chief gaseous product measured from the crystalline samples. Reliability of the CO_2 determinations after dissolution made this product the best basis of comparison between the chelates and their parent amino acid. $G(CO_2)$ values were: glycine, 1.02; cadmium diglycinate monohydrate, 0.21; zinc diglycinate monohydrate, 0.28; cobalt triglycinate dihydrate, 0.32; nickel diglycinate dihydrate, 0.34; copper diglycinate monohydrate, 0.45; alanine, 0.89; nickel alaninate dihydrate, 0.21; zinc alaninate monohydrate, 0.53; and copper alaninate monohydrate, 0.99. $G(NH_3)$ values were: glycine, 4.3; alanine, 3.3; copper diglycinate monohydrate, 1.0; and cadmium diglycinate monohydrate, 0.8. Qualitative and quantitative similarities between the chelates and their parent amino acid indicate similar decomposition mechanisms in agreement with the scheme proposed earlier by Tolbert. (auth)

25420 PULSE RADIOLYSIS OF SULPHUR COMPOUNDS. PART 2. FREE RADICAL "REPAIR" BY HYDROGEN TRANSFER FROM SULPHYDRYL COMPOUNDS. Adams, G. E. (Mount Vernon Hospital, Middlesex, Eng.); McNaughton, G. S.; Michael, B. D. Trans. Faraday Soc., 64: 902-10(Apr. 1968).

The intense transient absorption spectrum of the radical-anion $RSSR^-$ produced in the pulse radiolysis of cysteamine solutions, $NH_2CH_2CH_2SH$, (RSH), by the reaction $RS + RS^- \rightleftharpoons RSSR^-$ was used to measure the kinetics of hydrogen transfer reactions from the sulfhydryl group to a number of simple organic radicals. This radical repair process is first order in cysteamine concentration and depends upon the dissociation constants of the SH group. In oxygenated solutions containing methanol, oxygen competes with cysteamine for the radical $\cdot CH_2OH$. Rate data are presented and the mechanisms discussed. (auth) (UK)

25421 PHOTOCHEMICAL AND RADIATION-INDUCED REACTIONS OF PHOSPHORUS COMPOUNDS. Halmann, M. (Weizmann Inst. of Science, Rehovoth, Israel). pp 49-84 of Topics in Phosphorus Chemistry. Vol. 4. Grayson, Martin; Griffith, Edward J. (eds.). New York, John Wiley and Sons, Inc., 1967.

The topics discussed include: reactions of elementary phosphorus; photochemistry of tervalent phosphorus compounds; radiolytic oxidation of phosphorous acid and its esters; photochemistry of phosphoric acid anions and esters; radiolysis of phosphoric acid esters; ionization and fragmentation of phosphorus compounds by electron impact in the mass spectrometer; radioinduced reactions of phosphorus trichloride; and, radiation-induced polymerization of chlorophosphazenes. (137 references) (J.G.B.)

25422 VIBRATIONALLY EXCITED OZONE IN THE PULSE RADIOLYSIS AND FLASH PHOTOLYSIS OF OXYGEN. Hochanadel, C. J.; Ghormley, J. A.; Boyle, J. W. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 48: 2416-20(Mar. 15, 1968).

The kinetics of ozone formation have been studied in the pulse radiolysis and flash photolysis of gaseous oxygen by measuring the change in optical absorption following the pulse. The absorption spectrum of the ozone present immediately after the pulse was considerably broader and the peak was at longer wavelength (~2860 Å) than that of ground state ozone (~2500 Å). The initial absorption was attributed to ozone in the upper vibrational levels produced by $O + O_2 \rightleftharpoons O_3$. It is clearly shown that the over-all third-order reaction $O + O_2 + M \rightarrow O_3 + M$ occurs by a sequence of steps. The relaxation time for de-excitation from the upper vibrational levels to the ground state is $\geq 6 \times 10^{-6}$ sec in O_2 at 740 torr and 24°C. De-excitation required at least 4.5×10^4 collisions, and assuming 20 vibrational levels, the average efficiency was about one quantum in 2200 collisions. The third-order rate constant based on O atom disappearance $k_{(-O)}$ was several times larger than that based on formation of O_3 in the ground vibrational state $k_{(O_3, v=0)}$. Neither rate constant could be evaluated accurately by optical absorption measurements. Measurements at 2800 Å, where all vibrational levels appeared to have about the same extinction coefficient, gave a value $2.2 \times 10^8\ M^{-2}\ sec^{-1}$. This value should approximate $k_{(-O)}$ for which Kaufman and Kelso determined $2.4 \times 10^8\ M^{-2}\ sec^{-1}$ by direct measurement of O atom disappearance. Measurements at wavelengths below 2480 Å gave an upper limit for $k_{(O_3, v=0)}$ of $1 \times 10^8\ M^{-2}\ sec^{-1}$. (auth)

25423 THE IDENTIFICATION OF O_2^- ADSORBED ON MAGNESIUM OXIDE. Tench, A. J.; Holroyd, P. (Atomic Energy Research Establishment, Harwell, Eng.). Chem. Commun., No. 8, 471-3(1968).

Results are presented of ESR studies using ^{17}O, with a view to the positive identification of O_2^- on the surface of MgO, having a large concentration of electron excess surface centers formed by pre-γ-irradiation or photochemically. The spectrum showed a rich hyperfine structure, whereas unirradiated samples gave no ESR signal. Strong evidence was obtained that the adsorbed species was diatomic. The O_2^- ions were quite stable at room temperature and did not exchange detectably with the oxide ions of the lattice. It is noted that similar O_2^- ions formed by irradiation of MgO in the presence of oxygen exchange completely with the lattice oxide ions. (UK)

25424 PYROLYSIS OF A TETRAFLUOROETHYLENE–ACRYLONITRILE COPOLYMER. PART II. Fock, J. (Polytechnic Inst. of Brooklyn). J. Polym. Sci., Part A-1, 6: 969-77 (Apr. 1968).

The pyrolysis of copolymers obtained by radio-induced grafting of acrylonitrile onto polytetrafluoroethylene has been studied. Infrared spectroscopy shows disappearance of $-C \equiv N$ and appearance $-C=N-$ absorptions, indicative of the conjugation of the nitrile groups in the polyacrylonitrile segments. Aromatization is suggested by the appearance of aromatic C–H absorption and by the disappearance of aliphatic C–H absorption in the infrared spectra, as well as by the decrease of the C/H ratio and the constancy of the N content during exposure to 280°C shown by elementary analysis. Melting and remelting was studied by differential thermal analysis with respect to temperature, extent, and shape of peak area. An increase in the melting temperature proportional to the content of acrylonitrile in the copolymer was explained in terms of entropy effects. The melting peak obtained after grafting appeared as a doublet. The latter disappeared after annealing for 14 hr at 300°C and did not reappear on crystallization or on remelting. In addition, the areas obtained on first and repeated meltings showed a decrease that was proportional to the content of grafted polyacrylonitrile. These results were taken as an indication of an exothermic reaction involving crosslinking. The rate of disappearance of the $-C \equiv N$ absorption reaches a maximum at the melting temperature. It seems that the exothermic reaction occurring in the crystalline region is identical with "propagation crosslinking" suggested by others. It was concluded that an interesting new type of polymeric material has been found. (auth)

25425 ON THE SYNTHESIS AND PYROLYSIS OF A TETRAFLUOROETHYLENE–ACRYLONITRILE GRAFT COPOLYMER. PART I. Fock, J. (Polytechnic Inst. of Brooklyn). J. Polym. Sci., Part A-1, 6: 963-7(Apr. 1968).

Radioinduced grafting of acrylonitrile onto films of polytetrafluoroethylene has been studied. Irradiation has been carried out in a ^{60}Co gamma source at −78°C, and the graft polymerization was facilitated by being held at 100°C for 150 hr. The amount of acrylonitrile grafted per unit surface area apparently increased with the thickness of the film. Grafting was also accompanied by slight swelling. This indicates that the reaction occurs in depth. The relative decrease of the amount of grafted acrylonitrile with thickness of the film, referred to the weight of the film, showed that grafting is controlled by the diffusion of the monomer. The rate of grafting was found to be lower in a material with a higher degree of crystallinity; i.e., grafting occurred faster in the amorphous areas of the polymer. The final yield of graft decreased with the temperature at which the reaction was carried out. This may be explained on the basis of kinetics or by assuming a simultaneous disappearance of free polymer radicals. (auth)

25426 TWO-STAGE IRRADIATION STUDY ON PROPAGATION AND TERMINATION IN THE γ-RADIATION-INDUCED POLYMERIZATION OF ETHYLENE IN LIQUID CARBON DIOXIDE. Hagiwara, Miyuki; Mitsui, Horoshi; Machi, Sueo; Kagiya, Tsutomu (Japan Atomic Energy Research Inst., Gunma). J. Polym. Sci., Part A-1, 6: 721-8(Apr. 1968).

The propagation and termination reaction in the γ-radioinduced ethylene polymerization in liquid carbon dioxide were investigated by a two-stage irradiation. After irradiation at high dose rate, the polymerization occurred at a considerable rate under the extremely low dose rate without initiation. The absolute propagation rate was determined in the second stage to be proportional to the

square of ethylene fugacity and depended slightly on dose rate. The apparent activation energy for the propagation reaction is −9 kcal/mole. From these observations which are the same as those in bulk polymerization, it was concluded that carbon dioxide acts as a diluent of ethylene monomer in the propagation reaction. Also, carbon dioxide was found to be inactive to the growing radicals without irradiation, but oxygen, which is produced by the radiolysis of carbon dioxide at high dose, terminates the growing radicals with formation of carbonyl in the polymer. (auth)

25427 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF ALKYL METHACRYLATES ONTO POLYPROPYLENE. Kawase, Kaoru; Hayakawa, Kiyoshi (Government Industrial Research Inst., Nagoya, Japan). Nagoyo Kogyo Gijutsu Shikensho Hokoku, 16: 286-91(Sept. 1967). (In Japanese).

Six alkyl methacrylates were grafted onto polypropylene fibers by the γ simultaneous irradiation technique. In the grafting in which the backbone polymer was dipped into the liquid monomer, depending on the monomer used, large differences in the extent of grafting were observed together with the remarkable acceleration of the grafting rates. Monomers such as n-butyl and n-propyl methacrylates grafted to a very high extent, but the percentages of the grafting of isobutyl and isopropyl methacrylates were very low. From investigations on the homopolymerization occurring together with the grafting, bulk polymerization, and on the swelling of grafted products, the differences in the grafting with monomers were explained in terms of the relative concentration of monomers in the fibers. The tensile properties of grafted fibers were also investigated. (NSA of Japan)

25428 DETERMINATION OF THE RESISTANCE OF EXPLOSIVES TO GAMMA RADIATION AND TO HEAT. Piantanida, Erminio (Istituto di Chimica, Livorno, Italy). Chim. Ind. (Milan), 49: 851-3(Aug. 1967). (In Italian).

An apparatus for measuring the pressure of gases released by explosives either as a result of γ irradiation or as a result of heating is described. Applications to the study of γ irradiation are suggested. Pressures are measured manometrically, and it is not always possible to find a readable increase in pressure; this depends on the type of explosive and the dose. Pressures obtained are plotted against dose. The atmosphere must be controlled inside the decomposition chamber, since it can change during irradiation. The temperature should be maintained between 50 and 150°C. Charge density should be about 1:30 for 1 g explosive to 1:6 for 5 g; this value refers to the ratio of mass of explosive to the net volume of the decomposition chamber. Results for thermal studies are also described and graphed. (BBB)

25429 CHEMICAL CHANGES INDUCED BY HIGH-ENERGY RADIATION. THE PRESENT STATE OF OUR KNOWLEDGE. Ausloos, P. (Dept. of Commerce, Washington, D. C.). Scientia (Milan), 102: 418-31(1967).

A brief history of early progress in radiation chemistry is given. The chemical events which follow the passage of high-energy radiation through a system of molecules, in the gas phase, and in condensed phases, are outlined. The chemistry of free radicals is briefly discussed. Chemical analysis of certain products formed by irradiation of pure liquids or mixtures has yielded information on the free radical interactions occurring in the track. Unique information about the reactions of free radicals can be obtained in systems irradiated by high-energy radiation. Pulse radiolysis is a most useful tool in producing high concentrations of free radicals in gases and liquids. The recombination reaction between an electron and a positive ion $M^+ + e^- \rightarrow M^*$ called neutralization, usually yielding neutral excited species (M^*), is discussed. Geminate recombination is explained, and several recent results on conductivity in polar and nonpolar liquids during irradiation are given. (BBB) (TSS)

25430 DYNAMIC MECHANICAL BEHAVIOR OF A POLYIMIDE. Bernier, G. A.; Kline, D. E. (Pennsylvania State Univ., University Park). J. Appl. Polymer Sci., 12: 593-604(Mar. 1968).

The dynamic mechanical properties of a polyimide (poly-4,4′-oxydiphenylene pyromellitimide) were studied from about 4 to 800°K at audio frequencies. A prominent relaxation associated with absorbed water content occurred near 230°K. Below 270°K the modulus underwent a corresponding increase in value with increasing water content. Above 550°K the onset of a major process was observed in the modulus data, and a maximum in the internal friction was observed in about 675°K. Minor relaxation peaks were also noted throughout the temperature range. Relatively minor differences were noted in the mechanical relaxation spectra for the polyimide when treated (after drying) with dimethylformamide, dimethylacetamide, and dimethylsulfoxide, whereas the treatment with water after drying had a marked effect on the relaxation behavior. A reactor radiation dose of 3000 Mrad also caused only minor alterations in the dynamic mechanical spectra. (auth)

25431 STUDIES OF THE IODINE ADSORPTION ON PALLADIUM SURFACES. Toth, G. (Inst. for Isotopes, Budapest). Isotopenpraxis, 4: 60-3(Feb. 1968). (In German).

The absorption of microamounts of iodide ions on palladium surfaces was studied as a function of hydrogen and iodide ion concentration. The results showed that the amount absorbed per unit area, in contrast to platinum adsorbent was sufficiently high also in the alkaline range of pH value thus enabling the separation of carrier-free ^{131}I. In analogy to plantinum adsorbent, for anodically prepolarized adsorbent and in presence of reversible redox systems, the dependence on potential was independent of the prehistory of adsorbent, while for cathodically prepolarized adsorbent the influence of prehistory was observed. (auth)

25432 FISSION FRAGMENT AND NUCLEAR REACTOR IRRADIATION OF METHANE AND METHANE–HYDROCARBON MIXTURES. Farley, Carl Wiern. University Park, Pa., Pennsylvania State Univ., 1964. 300p.

Thesis.

Principal objectives of this work were: to develop experimental methods for studying fission-fragment irradiation of gases at varying temperatures and pressures with particular emphasis on dose measurement; to investigate the effects of diluents such as hydrogen and free-radical scavengers on methane decomposition with fission fragments; to gain a better understanding of the role played by unsaturates in the fission-fragment irradiation of methane; to compare the effects of reactor and fission-fragment radiation on the kind and distribution of products formed in the gas phase; and to present experimental data for preliminary economic evaluation of a fission-fragment process for methane decomposition. Mixtures to be irradiated were placed in a chamber containing a cylinder coated with enriched uranium oxide. The chamber was exposed to neutrons from the Penn State Reactor, which caused some of the uranium to fission and release fission fragments to the surrounding gas. The reactor-radiation apparatus was quite similar but contained no uranium-coated cylinder. Batch irradiations were carried out in both studies, and the irradiated gas was analyzed by gas chromatography. Experimental apparatus and techniques used in this work appear to be quite satisfactory for performing gas-phase, batch radiation-chemical reactions. It is believed that dose can be accurately estimated either by calculation if enough information is known about the neutron flux surrounding the uranium oxide plate and average fuel fission cross-section, or by monitoring the gaseous radioactive fission products in the irradiated gas. Hydrogen, gaseous hydrocarbons to C_5, and a viscous liquid composed mostly of C_{14} to C_{20} hydrocarbons are formed in γ and fission-fragment irradiation of methane. The only difference noted between γ and fission-fragment irradiated methane was in the concentration of unsaturated hydrocarbons. Some additional investigations, which concentrated on ethylene, indicated that the radiation dose rate may be an important variable particularly at very high dose rates. Hydrogen would likely be present in a recycle system designed to irradiate methane; hence, H_2 was added to methane in the batch irradiations to show what might be expected in the recycle case. Results showed that the concentration of unsaturated hydrocarbons, which were found to be small when pure methane is irradiated, would be still smaller with H_2 present. The studies with H_2 and ethylene additions to methane indicated that the formation of products can be explained largely on the basis of well known free-radical reactions. In fact, it was possible to compute product distributions and relative G values for the major compounds, which were in satisfactory agreement with experimental data using a simple model based on a free-radical mechanism. Considerable data were obtained that should be useful for anyone attempting an economic evaluation of a chemonuclear reactor for methane conversion; however, there was no attempt to make such an evaluation a part of this project. (Disser. Abstr.)

25433 PULSE RADIOLYSIS STUDY OF SOME TRANSITION METAL COMPLEXES. Waltz, William Lee. Evanston, Ill., Northwestern Univ., 1967. 206p.

Thesis.

The reactivity of the hydrated electron, e^-_{aq}, towards some transition metal complexes was investigated by the technique of pulse radiolysis. The complexes studied included those in which the metal is a member of the 2nd and 3rd row transition metals, in addition to some cobalt(III) complexes. The decay of e^-_{aq} was followed spectrophotometrically at 690 mμ after irradiation of aqueous methanol solutions by a μsec of high energy electrons. The rate of electron decay was found to be first order with respect to both the concentration of e^-_{aq} and that of the complex. In general the second order rate constants are of the order expected for dif-

fusion-controlled reactions. For the hexaammine complexes of the cobalt(III) series and for M(Et$_4$dien)Cl$^+$ where M is Pd(II) or Pt(II) and Et$_4$ dien is 1,1,7,7-tetraethyldiethylenetriamine, the order of reactivity towards e^-_{eq} can be correlated roughly with the loss in crystal field stabilization energy of the complex upon reaction with e^-_{aq}. A product study of irradiated aqueous methanol and ethanol solutions containing tris(2,2′-bipyridine)cobalt(III), Co(dipy)$_3^{+3}$, was carried out. Under conditions where the half-life for the reaction of e^-_{aq} and Co(dipy)$_3^{+3}$ was shorter than the period of observation, absorption changes were observed in the region of 400 to 615 mμ for periods up to 200 μsec after the radiation pulse. This was followed by a period of metastable equilibrium (<1 msec). From the effect of nitrous oxide on suppressing the absorption change at 578 mμ, the estimated half-life for dissociation of high spin Co(dipy)$_3^{+2}$ (160 msec), and the concentration of cobalt(II) found as a final product ([Co(II)] = [e^-_{aq}]$_{max}$), it is concluded that absorption changes were associated primarily with deactivation of electronically excited Co(dipy)$_3^{+2}$ (low spin). Support for this conclusion is derived from the fact that the rate of decrease in absorption at 485 and 578 mμ was enhanced in the presence of various compounds including Co(dipy)$_3^{+3}$. The compounds tried included a number, such as oxygen, that are known to quench electronically excited species. The rate constant, k_{obs}, associated with low spin Co(dipy)$_3^{+2}$ can be expressed as a sum of three terms, $k_{obs} = k_o + k_1$ [Co(dipy)$_3^{+3}$] + k_Q[Q] where the rate constants for the spontaneous deactivation, quenching by Co(dipy)$_3^{+3}$, and quenching by other substances are designated by k_o(≤5 × 10^3 sec^{-1}), k_1(~8 × 10^8 mole^{-1} sec^{-1}), and k_Q. The values of k_Q range from 10^6 to 10^{10} mole^{-1} sec^{-1}, and can be grouped according to the electrostatic charge and one electron reduction potential of Q. It is suggested that the quenching process may in some instances involve either redox or reversible charge transfer. The visible spectrum of low spin Co(dipy)$_3^{+2}$ is given, and positions of two regions of maximum absorption compare favorably with those predicted theoretically. Evidence is presented that indicates that both the hydrogen atom and alcohol radical react with Co(dipy)$_3^{+3}$. From studies in acid media it is hypothesized that the reaction of the H atom and Co(dipy)$_3^{+3}$ results in the formation of low spin Co(dipy)$_3^{+2}$. It is suggested that the mechanism for the reaction of the alcohol radical and Co(dipy)$_3^{+3}$ involves addition to the aromatic ligand. (Disser. Abstr.)

25434 TOPICS IN PHOSPHORUS CHEMISTRY. VOLUME 4. Grayson, Martin; Griffith, Edward J. (eds.). New York, John Wiley and Sons, Inc., 1967. 536p. $25.00.

Topics discussed include: structures and reactions of cyclopolyphosphines; natural occurrence of compounds with the carbon–phosphorus bond; chemistry of phosphorus halides; progress in the chemistry of fertilizer and soil phosphorus; and, phosphorus–nitrogen chemistry. A separate abstract has been prepared for the chapter on photochemical and radioinduced reactions of phosphorus compounds. Author, subject, and cumulative indexes are included. (J.G.B.)

For an abstract of one chapter see: 25421.

25435 (IS-T-216) RECOIL REACTIONS OF ATOMIC CARBON IN SYSTEMS OF SIMPLE OXYGEN CONTAINING ORGANIC MOLECULES. Palino, Gerard Francis (Ames Lab., Iowa). Feb. 1968. Contract W-7405-eng-82. 128p. Dep. CFSTI.

Thesis.

The dose and scavenger dependence of the yields of ^{11}C recoil products were determined for liquid methanol, ethanol, 1-propanol, 2-propanol, acetone, diethyl ether, methyl acetate, and methyl formate. The recoil carbon was produced in situ by the ^{12}C(γ,n)^{11}C reaction using the bremsstrahlung beam from an electron synchrotron. The labeled products were analyzed using standard radiogaschromatographic techniques. The results are interpreted in terms of the reactions of ^{11}C, ^{11}CH, ^{11}CH$_2$, and ^{11}CH$_3$ with the parent compound and the reactions of these radicals, other radical intermediates or product molecules with radiation produced radicals or added scavengers. Radiation modification of the primary products was observed. For methanol and ethanol relationships were established between a number of the dose dependent products. In methanol, the solvated electron and the ·CH$_2$OH radical were shown to be the primary radicals responsible for the dose dependence of the yields of labeled products: carbon monoxide, carbon dioxide, acetaldehyde, and 1,2-propanediol. It was observed that the intermediate carbenes insert more readily in the O–H than in the C–H bond. No evidence was obtained for the insertion of methyne or carbene radicals in the C–O bond, although carbon atoms appear to react with this bond. This reaction may be by way of a cyclic intermediate, thus accounting for the production of acetaldehyde and methyl acetate in methanol. A complete reaction scheme was proposed for the reactions of recoil carbon with methanol. The ethanol data were interpreted in light of the proposed reaction sequence in methanol. However, because of the increased complexity of this system, a detailed analysis was more difficult. The influence of molecular structure on the yields of the C_1 and C_2 products was studied in all of the compounds. The yield of ^{11}CO was interpreted in terms of a statistical model for carbon atom reactions. Although a few ambiguities exist in the model, the data give important insights into the mechanism for the production of ^{11}CO. In the alcohol and ether systems, this product was considered to result from the reaction of an energetic carbon atom with the nonbonding electrons on oxygen. The >C=O group was observed to be 2.7 times as reactive as the C–O–H or C–O–C group for formation of ^{11}CO. (auth)

25436 RADIOLYSIS OF AQUEOUS SOLUTIONS OF SODIUM THIOSULFATE AND OF SOLID DITHIONATES. Murthy, Gudi Sathya. Saskatoon, Saskatchewan, Univ. of Saskatchewan, 1967. 177p.

Thesis.

Aqueous solutions of $Na_2S_2O_3$ were irradiated with ^{60}Co-γ rays to yield $SO_4^=$ and H^+. Colloidal S was observed only at higher absorbed doses. The radiation products were estimated by analytical techniques based on nephelometry and microtitration. Sulfate yields increased with an increase in absorbed dose, acid yields increased in the earlier stages of irradiation and eventually reached a steady state value for irradiated aqueous solutions of $Na_2S_2O_3$. A mechanism is proposed, involving cleavage of S–S bond and the reaction of thiosulfate ions with the reactive intermediates formed in the irradiated water, for the radiolysis of aqueous $Na_2S_2O_3$ solutions. Solid dithionates, $Na_2S_2O_6 \cdot 2H_2O$, $Na_2S_2O_6$, $K_2S_2O_6$, $BaS_2O_6 \cdot 2H_2O$, and BaS_2O_6 were subjected to ^{60}Co γ radiation. The products $SO_3^=$, $SO_4^=$, and H^+ were estimated upon solution of irradiated solid dithionates in water. $SO_3^=$ and $SO_4^=$ were estimated nephelometrically and acid by microtitration. In the radiolysis of solid dithionates, yields of $SO_3^=$ and $SO_4^=$, and acid increased with an increase in absorbed dose. A mechanism proposed for the radiation decomposition of solid dithionates involves the cleavage of both S–S and S–O bonds. Thermal annealing experiments on irradiated $Na_2S_2O_6 \cdot 2H_2O$ and $BaS_2O_6 \cdot 2H_2O$ indicated no change in the yields of the products. However a change in the color of the irradiated salts was observed. Formation of free radicals within the irradiated solid dithionates was indicated by ESR spectroscopy. The spectra for most of the dithionate salts appeared to be a single absorption line except for anhydrous BaS_2O_6, where the spectrum was complicated. The spectroscopic splitting factor, g, was calculated. (Disser. Abstr.)

25437 RADIATION CHEMISTRY OF THE CHLOROACETIC ACIDS. Baxter, James Newell. Athens, Ga., Univ. of Georgia, 1967. 126p.

Thesis.

Radiation chemistry of aqueous solutions of the chloroacetic acids was studied with the intent to identify reaction intermediates and products and in the case of γ radiation to differentiate between direct and indirect action processes. For γ-irradiated aqueous solutions, Cl^-, CO_2, and CO were quantitatively identified for all three acids. In addition to these products, CH_2Cl, CH_2Cl_2, and CH_2ClCH_2Cl were measured for chloroacetic acid; CH_2Cl_2, $CHCl_3$, and $CHCl_2CHCl_2$ for dichloroacetic acid; CCl_4, C_2Cl_6, and C_2Cl_4 for trichloroacetic acid. C_2Cl_4 was evidently produced by the decarboxylation of the radiolysis product, CCl_3CCl_2COOH. The following intermediates were identified in the γ-irradiated solutions: ·CH_2Cl and ·CH_2COOH for chloroacetic acid; ·$CHCl_2$ and ·$CHClCOOH$ for dichloroacetic acid; and ·CCl_3 and ·CCl_2COOH for trichloroacetic acid. The ·CH_x-$Cl_{(2-x)}$ COOH radical is suggested rather than the ·$CH_{(x-1)}$-$Cl_{(3-x)}$ COOH radical as the more important species for chloroacetic and dichloroacetic acid primarily because of the high chloride yields in these systems, and because the scavenger employed inhibits a number of the usual hydrogen abstraction reactions. The scavenging technique used to identify these radicals did not differentiate between the two possibilities. The decomposition of aqueous solutions of the chloroacetic acids by radiation of 2537 Å produced Cl^-, CO_2, CO, and a principal alkyl halide for all three acids. The principal alkyl halide was CH_3Cl, CH_2Cl_2, and $CHCl_3$ for chloroacetic, dichloroacetic and trichloroacetic acid respectively and was produced with a low yield compared to that for chloride. Additional alkyl halides analogous to those produced in the γ-irradiated acids were also observed but yields were extremely low. A photo-induced exchange of Cl_2 between Cl^- and the chloroacetic acids was also observed. The evidence suggests that the initial reaction of the excited acid molecule or acetate ion is a dissociative process (e.g., $CCl_3COO^{-*} \rightleftharpoons CCl_2COO + Cl^-$). Evidence for this process was seen in the observed exchange of chloride and in the decrease of CO and CO_2 yields with added chloride. The principal reaction for trichloroacetic acid was evidently the quantitative decomposition of the acid molecule to CO, CO_2, and Cl^-. (Disser. Abstr.)

25438 IMPROVEMENTS IN AND RELATING TO POLYMERIC COMPOSITIONS. Lanza, Vincent Leonard (to Raychem Corp.).

British Patent 1,108,990. Apr. 10, 1968. Priority date Oct. 12, 1964, United States.

A polymer composed of vinylidene fluoride mixed with a quantity of at least 0.5 wt % triallyl cyanurate and irradiated with high energy radiation results in a polymeric vinylidene fluoride with improved thermal resistance and tensile strength. A process is described for the manufacture of heat-shrinkable tubing composed of this modified polymer that is irradiated after fabrication into tubing. (B.L.M.)

Radiochemistry

Refer also to abstracts 25261, 26234, and 26739.

25439 (COO-1617-4) THE INFLUENCE OF MOLECULAR PARAMETERS ON THE $^{79}Br(n,\gamma)^{80m}Br$ AND THE $^{82m}Br(I.T.)^{82}Br$ PROCESSES IN LIQUID HYDROCARBONS. Lambrecht, Richard M.; Rack, Edward P. (Nebraska Univ., Lincoln. Avery Lab. of Chemistry). Dec. 13, 1966. Contract AT(11-1)-1617. 10p. Dep. CFSTI.

By employing the freeze-thaw technique the (n,γ) and (I.T.) activated reactions of bromine were studied in various hydrocarbons ranging from pentane through undecane. The organic retention for the ^{80m}Br activated by (n,γ) was found to be proportional to molecular weight. Variations within a series of isomers may be explained by the radiation chemistry G-value for total organic radical production. Since the organic retention of ^{80m}Br appears to be proportional to G, it was concluded that Auger radiation and internal conversion are responsible for the organic retention. No correlation between the G-value, and the organic retention of the ^{82}Br activated by isomeric transition was found. However, the organic retention of ^{82}Br was a linear function, but not proportional to molecular weight. It is suggested that the (I.T.) reaction, although radical in nature is possibly influenced by additional processes. (auth)

25440 (MLM-1443) MOUND LABORATORY PROGRESS REPORT FOR CHEMISTRY: JULY–SEPTEMBER 1967. (Mound Lab., Miamisburg, Ohio). Sept. 29, 1967. Contract AT(33-1)-Gen-53. 64p. Dep. CFSTI.

Research progress is reported on: energies of gamma rays from ^{231}Pa, calorimetric half-life of ^{238}Pu, crystal chemistry, nuclear orientation, actinide tropolone complexes, separation of small quantities of boron in KCl–KF mixtures, neodymium–promethium separation, ^{234}U recovery, ^{229}Th recovery, techniques for measuring internal conversion coefficients, determination of ^{236}Pu in ^{238}Pu, low-level gas-phase proportional counting, x-ray diffraction patterns of neodymium ethyl sulfate nonahydrate, fast neutron spectroscopy, gamma dose rate measurements, and analysis of normal vibrations of polyatomic molecules. (M.C.G.)

Separation Processes

Refer also to abstracts 25235, 25274, 25275, 25314, 25330, 25333, 25374, 25440, 25515, 25564, and 25932.

25441 (ANL-7375) CHEMICAL ENGINEERING DIVISION SEMIANNUAL REPORT, JANUARY–JUNE 1967. (Argonne National Lab., Ill.). Oct. 1967. Contract W-7405-eng-38. 193p. Dep. CFSTI.

Eight sections are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual sections see: 25321, 25442–25444, 26270, 27086, 27397, and 27477.

25442 (ANL-7375, pp 19-45) COMPACT PYROCHEMICAL PROCESSES. (Argonne National Lab., Ill.).

Developments are reported for studies on: conceptual pyrochemical process for fast breeder reactor fuels; salt transport; distribution of elements between liquid alloys and molten salts; solubilities in liquid alloys; coprecipitation in liquid alloys; reactions of Mg alloys with molten $MgCl_2$; reactions of PuO_2 with molten salts; thermodynamics of the Pu–Zn–Mg system; and application of a pyrochemical process to the recovery of Pu and U from NaF beds on a laboratory scale; salt transport separations; continuous process equipment; containment of Cu–Mg–U/halide salt systems; purification of Ar from N with Ti sponge on engineering scale; zinc decladding of fast reactor fuel assemblies; removal of U from metal crucible by hydriding; absorption of molten salts by Fiberfrax; test facility for continuous pyroprocessing equipment; and fuel cycle facility operations. (P.C.H.)

25443 (ANL-7375, pp 46-94) FLUIDIZATION AND VOLATILITY PROCESSES. (Argonne National Lab., Ill.).

Developments are reported for studies on: fluorination of UO_2–PuO_2–fission product pellets in 2 in. dia reactor; reactions of cesium fluoride and plutonium fluorides; purification of Pu; neptunium fluoride chemistry; reaction of BrF_3 with U_3O_8; sorption of tellurium hexafluoride on solids; instrumental analyses; recovery of U and Pu from UO_2 fuels in engineering-scale alpha facility; UO_2 fuels; cleanup of cell exhaust air contaminated with PuF_6; bench-scale fluid-bed studies with irradiated fuels; particle motion in a two-dimensional bed; and mechanism of heat transfer between a fluidized bed and the wall. (P.C.H.)

25444 (ANL-7375, pp 180-9) STUDIES AND EVALUATIONS: PROBLEMS OF TRITIUM IN POWER REACTOR FUEL CYCLES. (Argonne National Lab., Ill.).

Developments are reported for studies on: management of tritium in aqueous wastes of fuel processing; tritium safety as established at the Nuclear Fuel Services processing plant; and behavior of tritium in nonaqueous processing. (P.C.H.)

25445 (BNWL-481-3, pp 42-8) EXPERIMENTAL DESIGN FOR THE PRELIMINARY STUDY OF CERTAIN GEOCHEMICAL PROCESSES. Ames, L. L. Jr.; Hajek, B. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A two-level factorial design was utilized for preliminary study of an ion exchange and a chemical reaction. The distribution of ^{134}Cs and ^{85}Sr between a soil column and an aqueous solution was studied. Two concentration levels of each of 4 factors ($NaNO_3$, HNO_3, KNO_3, and $Ca(NO_3)_2$) were combined in all possible combinations. (M.C.G.)

25446 (BNWL-481-3, pp 48-53) STRONTIUM AND CESIUM EQUILIBRIUM DISTRIBUTION COEFFICIENTS: BATCH AND COLUMN DETERMINATIONS. Hajek, B. F.; Ames, L. L. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Studies were made to determine the agreement between batch and column experimental methods used to determine equilibrium constants for cesium and strontium in macro and trace soil systems. In batch methods the solution-to-soil ratio used significantly affected the distribution coefficients in some systems. This was especially evident for trace cesium in ground water. Equilibrium distribution coefficients determined by use of small columns should eliminate volume effects. Some secondary reactions may cause some desorption during throughput. (M.C.G.)

25447 (BNWL-481-3, pp 54-9) CATION EXCHANGE PROPERTIES OF HEULANDITE–CLINOPTILOLITE SERIES MEMBERS. Ames, L. L. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The cation exchange characteristics of a synthetic zeolite, two natural clinoptilolites, and a heulandite were studied. The synthetic zeolite was intermediate in the heulandite–clinoptilolite series on the basis of correlated cation exchange characteristics and chemical composition. Data are presented in tables and graphs. Heulandite was more sodium-selective than clinoptilolite. The cesium selectivity of the zeolite is suggested as a criterion to distinguish between samples within a structural series such as the heulandite. (M.C.G.)

25448 (BNWL-481-3, pp 59-63) TRIVALENT CERIUM EQUILIBRIA WITH A SYNTHETIC HEULANDITE–CLINOPTILOLITE SERIES ZEOLITE. Ames, L. L. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The cation exchange properties of a synthetic member of the heulandite–clinoptilolite series were determined. Unusually good cerium selectivity was displayed for a high-silica zeolite of this structural series. The zeolite was synthesized in a stirred 1 liter autoclave held at 290°C for 5 days at autogenous pressure; starting materials were LiOH, ground $Al(OH)_3$, and ground silica gel. Three cerium capacity determinations were performed and the values obtained were 1.14, 1.18, and 1.16 meq Ce/g zeolite. (M.C.G.)

25449 (CEA-N-616, pp 72-85) TRAITEMENT DES EFFLUENTS MOYENNEMENT ET FAIBLEMENT ACTIFS. (Processing of Moderately and Weakly Active Effluents). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: decontamination with the aid of surface-active agents; decontamination by ion exchange; processing radioactive liquid effluents by evaporation; and various other procedures. (P.C.H.)

25450 (CEA-N-616, pp 86-96) TRAITEMENT DE L'URANIUM. (Processing Uranium). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: processing uranium minerals; processing enriched uranium; new methods for processing uranium; and prototypes of apparatus and ensembles of chemical engineering for uranium processing. (P.C.H.)

25451 (CEA-N-616, pp 145-51) ETUDES CHIMIQUES DIVERSES. (Diverse Chemical Studies). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: effects of ultrasound on Cu-Ni deposits; furnace for fabrication of monocrystals; separation and processing of Zr and Hf; and preparation of special products. (P.C.H.)

25452 (CEA-N-616, pp 154-214) ETUDE DES PROCEDES DE TRAITEMENT DES COMBUSTIBLES IRRADIES PAR VOIE AQUEUSE-LABORATOIRE. (Study of the Procedures for Processing Irradiated Fuels by Aqueous Methods-Laboratory). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: fuels with natural uranium base; fuels with enriched uranium base; plutonium fuels from breeder reactors; purification of Pu by tridodecylamine; and regeneration of used solvents. (P.C.H.)

25453 (CEA-N-616, pp 215-45) ETUDE DES PROCEDES DE TRAITEMENT DES COMBUSTIBLES IRRADIES PAR VOIE AQUEUSE-ATELIER PILOTE. (Study of the Procedures for Processing Irradiated Fuels by Aqueous Methods-Pilot Plant). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: conclusion of the campaign for processing U-Mo alloys irradiated during spring of 1965; apparatus for chemical engineering; exploitation and perfection of hot cells; and laboratory works. (P.C.H.)

25454 (CEA-N-616, pp 246-94) ETUDE DES PROCEDES DE TRAITEMENT DES COMBUSTIBLES IRRADIES PAR VOIE SECHE. (Study of the Procedures for Processing Irradiated Fuels by Dry Method). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: volatilization of halides; processing of U-Zr and U-Al alloys; separation of U-Pu starting with mixtures of their hexafluorides; detection of volatile radioactive fluorides; and dry electrolyses. (P.C.H.)

25455 (CEA-N-616, pp 295-368) PREPARATION ET ETUDE D'ISOTOPES LOURDS. (Preparation and Study of Heavy Isotopes). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: electrolytic preparation of Pu; extraction of ^{237}Np; recovery of Np on a semi-industrial scale; final purification and transformation of NpO_2; production of transplutonium elements; fabrication of targets; chemical processing of Al-Pu alloys; production chain for transuranium elements; chemistry of actinides; application of coincidences in radiochemical analysis; determination of fission products by γ and α spectrometry; and α and γ radiometric analysis in the pilot plant. (P.C.H.)

25456 (CEA-N-616, pp 369-434) ETUDE DE LA VITRIFICATION DES SOLUTIONS DE PRODUITS DE FISSION. (Study of the Vitrification of Solutions of Fission Products). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: composition of glasses; elimination of Hg from fission product solutions; pot vitrification of fission product solutions; and continuous calcination of molybdic solutions. (P.C.H.)

25457 (IEA-131) AN ION EXCHANGE-EDTA SEPARATION OF LEAD FROM BISMUTH. APPLICATION TO RADIOCHEMISTRY. Abrao, Alcidio (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec. 1966. 12p. (CONF-115-4). Dep.

From Inter American Nuclear Energy Commission Pan American Conference on Radiochemistry, Montevideo, July 1963.

Separation of lead from bismuth is suggested based on the principle that the EDTA (Ethylenedinitrilotetraacetic acid) complex of bismuth is very stable in acid solutions while lead is not complexed. By percolating a solution containing lead, bismuth, and EDTA, at pH 1.8 to 2.5 in a cationic ion exchange column, the lead ions are completely adsorbed by the resin while bismuth is eluted as the complex. This separation was radiochemically controlled using ^{212}Pb and ^{212}Bi as tracers. It was successful when both elements were in tracer concentration or when one (or both) of them was at macro concentration. In a single-step separation both elements were obtained in a purity of about 99% even when both were at tracer concentration. The purity of the bismuth fraction was checked by gamma spectrometry, looking for the 0.23-MeV photopeak for ^{212}Pb and by radioactive decay. The contamination of lead in the bismuth fraction was also calculated by comparison of the areas under the 0.23-MeV photopeak in both fractions. The purity of the fractions was verified by the radioactive growing curve by beta counting using an aluminum absorber of 352 mg/cm^2. The transient equilibrium time was determined and found in agreement with the theoretical (3.76 hours). The procedure is simple and rapid, which is important when the half-lives of the isotopes are short. (auth)

25458 (K-L-6120) ENGINEERING-SCALE STUDIES OF BORON ISOTOPE SEPARATION USING THE BORON TRIFLUORIDE-ANISOLE COMPLEX. Merriman, J. R.; Pashley, J. H.; Smiley, S. H. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1966]. Contract W-7405-eng-26. 24p. (CONF-660907-14). Dep. CFSTI.

From 152nd National Meeting of the American Chemical Society, New York.

An equilibrium distillation process employing a gaseous mixture of BF_3 and anisole was studied for the separation of boron isotopes. A summary of pertinent system design information is given. Stage lengths and flooding characteristics, solvent degradation, complex dissociation and recombination, anisole purification and drying, and suitability of construction materials were investigated. (M.C.G.)

25459 (KFK-672) UEBER CHELATBILDUNG UND EXTRAKTION DES DREIWERTIGEN ACTINIUMS, AMERICIUMS, CURIUMS UND CALIFORNIUMS MIT ACETYLACETON UND EINIGEN SEINER DERIVATE. (Complexing and Extraction of Trivalent Ac, Am, Cm, and Cf with Acetylacetone and Several of its Derivatives). Schreck, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Dec. 1967. 83p. (In German). Dep.

The complexing and extraction behavior of the trivalent elements Ac, Am, Cm, and Cf were investigated with the following chelating agents: acetylacetone (HAa) trifluoroacetylacetone (HTAa), hexafluoroacetylacetone (HHAa), 2-furoyltrifluoroacetone (HFTA), 2-thenoyltrifluoroacetone (HTTA), benzoyltrifluoroacetone (HBTA), naphthoyltrifluoroacetone (HNTA), and β-isopropyltropolone (HIPT). The distribution coefficient, λ_N, of the chelates is rigidly bound with that of the chelating agents and increases in the series Ac^{3+}, Am^{3+}, Cm^{3+}, and Cf^{3+} and with decreasing ion radius. The $pH_{\frac{1}{2}}$ values decrease in this sequence; they are rigidly connected with the dissociation constants of the chelating agents. HTTA, HBTA, HNTA, and HIPT extract Am^{3+}, Cm^{3+}, and Cf^{3+} as the pure 1:3 chelate, but deviations from the 1:3 stoichiometry occur in the other systems. The total stability constants, β_3, and the extraction constants, K_{ex}, of the 1:3 chelates were calculated by a simple numerical method. The β_3 values increased in the series Ac^{3+}, Am^{3+}, Cm^{3+}, and Cf^{3+} or HTTA, HBTA, HNTA, and HIPT. Chelates with HIPT, which form a five-membered ring, are, as expected, considerably more stable than the chelates of the 1,3-diketones, which have a six-member ring structure. By application of the graphic limiting value method, the constants β_1 and β_2 of Am with HTTA were calculated as $\lg \beta_1 = 3.4$ and $\lg \beta_2 = 8.5$. Because of the very scattered measurement point, which leads to large errors in the β_1 and β_2 constants to be determined, a calculation in the usual 1:3 chelate was not made. The acetylacetonates of Nd, Pr, Sm, Eu, and Am and the BTA and TTA chelates of Eu and Am can be prepared in pure form. The thermal decomposition leads, without detectable intermediate steps, directly to the metal oxides. Hexone (methyl isobutyl ketone) (A) forms adduct chelates with $Am(BTA)_3$ and $Am(TTA)_3$ in relation to the hexone concentration. The adduct stability constants β_1' and β_2' were determined by a graphic method as $\lg \beta_1' = 1.18$ and $\lg \beta_2' = 1.56$ for $Am(TTA)_3 \cdot yA$ and $\lg \beta_1' = 1.31$ and $\lg \beta_2' = 1.68$ for $Am(BTA)_3 \cdot yA$. The pK value of HBTA and HNTA and the distribution coefficients of these substances between chloroform and water were determined spectrophotometrically and the pK value of HFTA by potentiometric methods. A computer program for the IBM 7074 in FORTRAN II was developed for the calculation of the anion concentration of the chelating agent. (tr-auth)

25460 (KFK-673) UEBER DIE AUFLOESUNG VON PuO_2-HALTIGEN BRUETERBRENNSTOFFEN IN SALPETERSAEURE FUER DIE WAESSRIGE WIEDERAUFARBEITUNG NACH DEM PUREX-VERFAHREN. (On the Dissolution of PuO_2-Containing Breeder Fuels in Nitric Acid for Aqueous Reprocessing by the Purex Method). Baehr, W.; Dippel, Th. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). July 1967. 21p. (In German). (EUR-3704). Dep.

The dissolution behavior of unirradiated PuO_2 powder and UO_2-15% PuO_2 sintered pellets was investigated in relation to varying sintering data. Dissolution rates and residues were determined after 8 hr in 14M HNO_3. It was found that UO_2-15% PuO_2 pellets at 1500°C after 32 hr, at 1600°C after 16 hr, and at 1700°C after 8 hr exhibit extensive mixed phases and are therefore completely soluble. With these results the question of the reprocessing of breeder fuels is answered positively. If the fuel is subjected to sintering conditions such that extensive mixed crystals are formed

between PuO_2 and UO_2, it is possible to achieve dissolution without special difficulty. The solutions resulting from this dissolution can be diluted until they are doubled in volume and then used as feed solutions for the Purex Process. (tr-auth)

25461 (ORNL–3954) SAFETY ANALYSIS FOR THE TRANSURANIUM PROCESSING PLANT, BUILDING 7920. King, L. J. (comp.) (Oak Ridge National Lab., Tenn.). Apr. 1968. Contract W-7405-eng-26. 186p. Dep. CFSTI.

A safety analysis is presented of the Transuranium Processing Plant and the proposed operations and procedures. The topics covered are: a description of the building and building services, with special emphasis on provisions for containment of hazardous materials; processes and equipment; operating safeguards; control of personnel exposure; operations with transuranium elements in the development laboratories, including laboratory hazards and safeguards; radiation and contamination controls; process safeguards; waste disposal; and process hazards and credible accidents. The purpose of the Transuranium Processing Plant (TRU) is to recover transuranium elements from irradiated targets for distribution to research workers and to refabricate targets from some of the intermediate isotopes, especially americium and curium. After target dissolution, the heavy elements are separated from fission products, and the transcurium elements are separated from curium in two cycles of solvent extraction in 1.5-in. dia pulsed-column contactors. The transcurium elements are separated from each other and purified, by batch solvent extraction and ion exchange. Most of the americium and curium is refabricated remotely into new targets for reirradiation in the High-Flux Isotope Reactor. The alpha-emitting, spontaneously fissioning actinides present novel problems in radiochemical plant design. The combination of the fast-neutron flux and penetrating gamma rays from fission products and spontaneous fission requires shielding considerations that are normally associated with reactors. The containment of radionuclides in TRU is complicated because many of the isotopes of the transuranium elements have high specific toxicities and because the plant and equipment must be capable of accommodating extensive changes. (auth)

25462 (ORNL–4229) REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1967. (Oak Ridge National Lab., Tenn.). Mar. 1968. Contract W-7405-eng-26. 218p. Dep. CFSTI.

Research progress is reported in 15 sections. A separate abstract was prepared for each section. (M.C.G.)

For abstracts of individual sections see: 25327–25333, 25374, 25375, 26029, 26070, 26093, 26094, 27455, and 27490.

25463 (ORNL-TM–907(Rev.)) MSRE DESIGN AND OPERATIONS REPORT. PART VII. FUEL HANDLING AND PROCESSING PLANT. Lindauer, R. B. (Oak Ridge National Lab., Tenn.). Dec. 28, 1967. Contract W-7405-eng-26. 65p. Dep. CFSTI.

This revision covers changes in equipment and operating plans over the past 3 years. Detailed descriptions are given of the processes for H_2–HF treatment and uranium recovery, and of the equipment. Results of a safety analysis are also given. (D.L.C.)

25464 (STI/DOC-10/82) TREATMENT OF LOW- AND INTERMEDIATE-LEVEL RADIOACTIVE WASTE CONCENTRATES. Technical Report Series No. 82. Report of a Panel. (International Atomic Energy Agency, Vienna (Austria)). 1968. 120p. IAEA: $2.50; Austrian Schillings 65,–; Pound 1.0.10; F Fr 12,30; DM 10,–.

A panel of thirteen international experts was convened to discuss the treatment of low- and intermediate-level radioactive waste concentrates. Reports are given on the following treatment processes: concentration by evaporation; filtration; fixation by means of bitumens; and the use of cement or cement-vermiculite. The operating costs of different processes used at specific locations throughout the world are tabulated. The results of an investigation of techniques being used to determine leach rates of solid wastes are reported, and a proposal is made for a standard method for determining leach rate. (L.C.L.)

25465 (SZS–3/68) EINSATZ SCHWACH SAURER KATIONENAUSTAUSCHER ZUR DEKONTAMINATION RADIOAKTIVER ABWAESSER. REGENERIERUNG DER SYNTHETISCHEN IONENAUSTAUSCHER WOFATIT KPS, SBW, UND SBK NACH DER BELADUNG MIT RADIOAKTIVEN ABWAESSERN. (Application of Weakly Acid Cation Exchanger for the Decontamination of Radioactive Waste Water. Regeneration of the Synthetic Ion Exchangers Wofatit KPS, SBW, and SBK After Loading with Radioactive Waste Water). Bosholm, J.; Richter, D. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Jan. 1968. 51p. (In German). Dep.

The effects of salt content on the distribution of cesium and strontium between cation exchange resins and the aqueous phase were investigated. After a precipitation step, column operations with a weakly acid exchanger and labeled tap water gave breakthrough volumes of 2,100 bed volumes and 6,000 bed volumes for ^{137}Cs and ^{89}Sr. The decontamination factors for the total process were 270 and 1,630, respectively. For ^{60}Co and ^{144}Ce the exchanger was ineffective but the concentration of both nuclides was decreased by the precipitation step. Regeneration of the resin was possible with a slight excess of acid. (auth)

25466 (UCRL–50404) RECOVERY OF EINSTEINIUM FROM ISOTOPE SEPARATOR PARTS. Morrow, Richard J. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 1, 1968. Contract W-7405-eng-48. 4p. Dep. CFSTI.

A method is described for recovering small amounts of trivalent actinides such as einsteinium that are left on the surfaces of isotope separator parts. The contaminated parts are leached with appropriate common mineral acids to remove the actinides, and the resulting solutions are converted to nitric acid, combined, and concentrated. This concentrated solution is adjusted to at least 8M in nitric acid, mixed with 80 to 90 vol % methanol, and run through an ion exchange column, which holds the trivalent actinides and passes the impurities. (auth)

25467 (UJV–1912) EXTRACTION OF NITRIC ACID, URANIUM, PLUTONIUM, AND FISSION PRODUCTS BY PHOSPHONATES, PHOSPHINATES, AND PHOSPHINE OXIDES. III. EXTRACTION OF ZIRCONIUM AND NIOBIUM AND SEPARATION OF URANIUM FROM THESE FISSION PRODUCTS. Talas, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Dec. 1967. 31p. Dep.

The extraction of ^{95}Zr–^{95}Nb isotopes by butyl esters of phosphonic and phosphinic acids (of the $(BuO)_2$:PO.R and BuO.PO:R_2 types, resp., where R = methyl, butyl, i-amyl, and phenyl), and trialkyl phosphine oxides (R_3PO type, where R = butyl and hexyl) was investigated. The dependence of the extraction of zirconium and niobium on the concentration of nitric acid, salting-out agent ($NaNO_3$), and extractant both in the presence and absence of uranyl nitrate was studied as well as the dependence on the concentration of uranyl nitrate itself. The extraction of these isotopes from acid-deficient solutions of uranyl nitrate was also studied. The results obtained were also utilized for evaluating the efficiency of the separation of uranium from zirconium and niobium. (auth)

25468 (UJV–1929) INFLUENCE OF PHASE RATES ON WORKING REGIONS OF HORIZONTAL PULSED EXTRACTOR. Meznik, F.; Sraier, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Dec. 1967. 19p. Dep.

Work regions for the systems water–CCl_4, water–n-$C_{12}H_{26}$, 1M HNO_3–30% TBP in n-$C_{12}H_{26}$, and 1M HNO_3–70% TBP in n-$C_{12}H_{26}$ were determined in a horizontal pulse extractor at a constant heavy or light phase as well as at a constant ratio or sum of the rates of the two phases. The sum of the rates of the two phases has a decisive influence on the work region. In all the systems studied the pulse frequency did not depend on the ratio of the two phases at either the upper or lower flooding limits. At both flooding limits the pulse frequency was a linear function of the ratio sum of the two phases. In view of this relationship a given hydrodynamic system can be explicitly characterized by determining a single work function for a rate ratio of the two phases equal to unity. (auth)

25469 (Y-MA–777) A GUIDE TO THE CLASSIFICATION OF URANIUM SCRAP. Barkman, J. R. (comp.) (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). June 1966. Contract W-7405-eng-26. 14p. (CONF-660616–5). Dep. CFSTI.

From 7th Annual Inst. of Nuclear Materials Management Meeting, Columbus, Ohio.

The guide was prepared to help the generator and the processor in recovering and measuring the uranium. The classification system identifies material by major grade, subgrade, and degree of isotopic enrichment; four-digit identification code numbers are used. The major grades and subgrades are described. (D.L.C.)

25470 (ANL-Trans–590) REPROCESSING OF IRRADIATED FUELS BY VOLATILIZATION. REGENERATION OF CERAMIC FUELS. Final Report, 1967. Schmets, J.; (and others) (European Atomic Energy Community). Translated for Argonne National Lab., Ill., from report EUR–2882. 140p. Dep. CFSTI. JCL $10.50 fs, $4.10 mf.

Chlorine trifluoride and fluorine can both be used for the reprocessing of ceramic fuels in the form of mixed $(U,Pu)O_2$ oxides. Chlorine trifluoride has not only the property of directly transforming compact uranium dioxide into hexafluoride, but also reacts with the pulverulent fuel. In the experiments carried out, the phenomenon of agglomeration of powders did not take place. Thus

ClF_3 is well adapted to the different forms that the fuel can be coated with after irradiation and decladding. Useful technological information was also collected on the subject of a reaction project using fluorine to simultaneously volatilize uranium and plutonium. A hot semi-pilot installation for evaluation of two reprocessing cycles is in construction. A series of experiments should facilitate the use and increase the safety of this installation. Investigations were carried out on conditions for pulverization of uranium carbide with the object of the subsequent formation of hexafluoride. Data were also collected on the direct reaction between uranium monocarbide and chlorine trifluoride. The problem of the conversion of uranium and plutonium fluorides into oxides was the object of an examination. (auth)

25471 (MLM-1491(tr)) STUDY OF THE SEPARATION BY THERMAL DIFFUSION OF SOME ISOTOPES OF Xe. Saviron, J. M.; Gonzalez, D.; Madariaga, J. A.; Quintanilla, M. Translated for Mound Lab., Miamisburg, Ohio, from An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 83-90(1967). 17p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 28065. (P.C.H.)

25472 (ORNL-tr-1765) AT 1: LINK IN THE FRENCH FAST BREEDER SERIES RESEARCH PROGRAM. Amaury, Paul; Talmont, Xavier. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Energ. Nucl. (Paris), 9: 113-19(Mar.-Apr. 1967). 20p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 27835. (P.C.H.)

25473 REPROCESSING INSTALLATION AT KARLSRUHE: CONSTRUCTION, MODE OF OPERATION, AND OBJECT IN VIEW. Huppert, Karl-Ludwig (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH, Karlsruhe, Ger.). At. Strom., 14: 9-12(Jan. 1968). (In German).

The development of a part of a section for the fuel cycle for nuclear fuels is described. The installation described is to be used to gain experience with a tried and tested technology, and to further develop it. (auth)

25474 ION EXCHANGE SEPARATION OF SOME RARE EARTHS AND ACTINIDES UNDER OPTIMUM CONDITIONS WITH α-HYDROXYISOBUTYRIC ACID. Hoehlein, G.; Born, H.-J. (Technische Hochschule Munich, Garching, Ger.). Radiochim. Acta, 8: 172-5(Dec. 1967).

In order to find optimum conditions for actinide and lanthanide separations on Dowex 50WX12 with α-hydroxyisobutyric acid as eluant the influence of p_H on α-hydroxyisobutyrate activity was investigated. By means of p_H gradient elution rare earths in trace and mg amounts were completely separated from each other. This technique allows separation of trace amounts of ^{242}Cm from mg amounts of neutron-irradiated ^{241}Am in the presence of some fission products. (auth)

25475 SEPARATION OF TELLURIUM NUCLEAR ISOMERS IN DIMETHYLTELLURIUM DIIODIDE AND DIMETHYLTELLURIUM PICRATE. Carrillo, Lila; Nassiff, S. J. (Instituto de Asuntos Nucleares, Bogota). Radiochim. Acta, 8: 124-7(Dec. 1967).

The separation of the nuclear isomers ^{127m}/^{127g}Te and ^{129m}/^{129g}Te previously bound to dimethyltellurium diiodide and dimethyltellurium picrate, in which the tellurium was in the tetravalent form was studied. A separation yield of 94.5 ± 3.5% and 61.4 ± 1.1% for ^{127m}/^{127g}Te and ^{129m}/^{129g}Te, respectively, was found in the dimethyltellurium diiodide. In the dimethyltellurium picrate, the yield was 93.4 ± 3.4% for ^{127m}/^{127g}Te and 64.5 ± 4% for ^{129m}/^{129g}Te. The tellurium isomers in ground state were isolated carrier free. (auth)

25476 BEHAVIOR OF PRODUCTS OF IRRADIATION IN THE HIGH-TEMPERATURE TREATMENT OF NEUTRON-IRRADIATED URANIUM DIOXIDE. Lux, Franz; Graw, Dieter; Vogel, Joerg (Technische Hochschule, Munich). Radiochim. Acta, 8: 132-42(Dec. 1967). (In German).

Earlier investigations, carried out to study the behavior of fission products and transuranium elements in heterogeneous reactions between neutron-irradiated uranium compounds and gaseous or liquid phases containing a complexing agent, were extended to reactions between solid uranium compounds and other solid phases. The experiments were done under argon in a Tammann furnace. The starting material was neutron-irradiated UO_2. The material of the crucible (graphite or Al_2O_3) acted as the other solid phase. In reactions occurring between 1140 and 1880°C the elements Sr, Ba, Te, Mo, and Ru were separated quantitatively; in the same temperature range the elements Nd, Ce, and La were partly separated (38-74%). The separation of the fission products depends specifically on the material of the crucible. This effect is explained by "microscopic heterogeneous solid-state reactions" between the fission products and the material of the crucible; these reactions are thought to cause a volatilization of the fission products in elementary or oxide form. The results are discussed in view of a possible application to reprocessing of spent fuel elements. (auth)

25477 ^{226}Ra LIBERATION FROM URANIUM ORE PROCESSING MILL WASTE SOLIDS AND URANIUM ROCKS INTO SURFACE STREAMS. I. THE EFFECT OF DIFFERENT pH OF SURFACE WATERS. Havlik, Borivoj; Grafova, Jaroslava; Nycova, Bedriska (Inst. of Hygiene, Prague). Health Phys., 14: 417-22(May 1968).

Intensive uranium ore mining and processing cause increasing contamination of surface waters with natural radioactivity, often over large areas. Most of the radioactive wastes penetrating into surface waters (mine waters, effluents from uranium ore processing mills, wash down from dumps and overburdens) contain radioactive isotopes bound to sedimenting matter. The results are presented of experimental studies of the dependence of radium release from ores and sediments on hydrogen ion concentration in surface waters. Dried homogenized samples of uranium ore and sediments containing ^{226}Ra to 14 pCi/g, 84 pCi/g, and 540 pCi/g were shaken for 15, 30, 60, 180, 300, and 480 min with water of pH in the range of 1 to 13. A maximum amount of radium was leached in 15 to 30 min of shaking when pH was 1 (22%). With increasing pH the amount of released radium decreased (to pH 9). (auth) (UK)

25478 ^{226}Ra LIBERATION FROM URANIUM ORE PROCESSING MILL WASTE SOLIDS AND URANIUM ROCKS INTO SURFACE STREAMS. II. THE EFFECT OF DIFFERENT CHEMICAL COMPOSITION OF SURFACE WATER. Havlik, Borivoj; Nycova, Bedriska; Grafova, Jaroslava (Inst. of Hygiene, Prague). Health Phys., 14: 423-30(May 1968).

Surface water contaminated by radioactive waste from uranium ore mining and processing showed higher concentrations of dissolved radium in places several kilometers from the place of outlet of the wastes than in the outlet itself. The influence of inorganic salt concentrations was studied. Homogenized and dried samples of uranium ores and sediments were shaken with distilled water together with 1 N, 0.1 N, and 0.01 N concentrations of $BaCl_2$, $SrCl_2$, $MgCl_2$, $CaCl_2$, LiCl, NaCl, KCl, $(NH_4)_2SO_4$, Na_3PO_4, K_3PO_4, and $MgCO_3$ salts. It was found that 95 to 100% of radium bound in sediments was released in 1 N solutions of KCl and NaCl dependent on the structure and mineralogical composition of the sediment. A positive effect on the leachability of radium was also shown by $CaCl_2$ solution. (auth) (UK)

25479 QUANTITATIVE SEPARATION OF BARIUM FROM STRONTIUM AND OTHER ELEMENTS BY CATION EXCHANGE CHROMATOGRAPHY IN HYDROCHLORIC ACID-ORGANIC SOLVENT ELUENTS. Strelow, F. W. E. (National Chemical Research Lab., Pretoria). Anal. Chem., 40: 928-31(May 1968).

Cation exchange distribution coefficients for Ba and Sr in mixtures of HCl with the organic solvents methanol, ethanol, acetone, and dioxane are presented with AG50W-X8 and AG50W-X12 resins. A method for the quantitative separation of Ba from Sr and other elements is described. Sr is eluted from a column of 60 ml AG50W-X8 resin of 200- to 400-mesh particle size by 3.0 M HCl containing 20% ethanol at a flow rate of 2.5 ± 0.3 ml per minute. Ba is retained by the column and can be eluted with 3M HNO_3. Al, Ca, Mg, Fe(III), Ti(IV), Mn(II), Cu(II), Co(II), Ni(II), Zn, Cd, U(VI), Ga, In, Pb(II), and most other elements accompany Sr quantitatively. Zr, Hf, and Th accompany Ba, but are retained by the column when Ba is eluted with 2M HNO_3. The rare earths interfere and have to be removed by an extra separation step. An elution curve for the favored eluent concentration and results on quantitative separations of synthetic mixtures are included. (auth)

25480 SEPARATION OF MILLIGRAM QUANTITIES OF AMERICIUM AND CURIUM BY EXTRACTION CHROMATOGRAPHY. Horwitz, E. P.; Bloomquist, C. A. A.; Orlandini, K. A.; Henderson, D. J. (Argonne National Lab., Ill.). Radiochim. Acta, 8: 127-32(Dec. 1967).

The separation of milligram quantities of americium and curium was carried out by extraction chromatography using a high-molecular-weight quaternary ammonium nitrate (Aliquat-336 nitrate) absorbed by hydrophobic diatomaceous earth. $LiNO_3$ solution was used as the elutriant. The method was particularly advantageous for obtaining curium highly decontaminated from americium (<60 ppM Am) and was applied to the purification of 10 Ci of ^{242}Cm. Complete separations were achieved in two hours operating at room temperature. Preliminary studies of the ef-

fect of capacity of the column material on column performance and the effect of nitrate normality on the separation factor, Am(III)/Cm(III), were also carried out. (auth)

25481 STUDIES ON THE EXTRACTION OF URANIUM FROM SEA WATER. Keen, N. J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Brit. Nucl. Energy Soc., 7: 178-83 (Apr. 1968).

The oceans can be regarded as a vast reserve of a liquid low grade ore of well defined composition containing uranium at 3.34 μg/l. Studies were made on extracting U from sea water by absorption on hydrous TiO_2. The absorber has been developed to a point where, although deficient in some respects, it shows a high capacity for absorbing U. Uranium can be eluted from the absorber by $(NH_4)_2CO_3$ solution, but a small proportion appears to be held firmly. For a large scale extraction plant, a system of two tidal lagoons, similar to that employed for tidal power schemes, was considered for providing the head of water necessary to pass sea water through the absorber. (auth) (UK)

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A process for removing acid impurities from metal oxide sols without the use of ion exchange resins consists of extracting the acid impurities with a water-insoluble amine in a water-insoluble organic solvent. A 0.05 to 0.4M solution of the amine in the organic solvent should be used, and the process is particularly applicable to the purification of actinide oxide sols. (B.L.M.)

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ClF_3 is well adapted to the different forms that the fuel can be coated with after irradiation and decladding. Useful technological information was also collected on the subject of a reaction project using fluorine to simultaneously volatilize uranium and plutonium. A hot semi-pilot installation for evaluation of two reprocessing cycles is in construction. A series of experiments should facilitate the use and increase the safety of this installation. Investigations were carried out on conditions for pulverization of uranium carbide with the object of the subsequent formation of hexafluoride. Data were also collected on the direct reaction between uranium monocarbide and chlorine trifluoride. The problem of the conversion of uranium and plutonium fluorides into oxides was the object of an examination. (auth)

25471 (MLM–1491(tr)) STUDY OF THE SEPARATION BY THERMAL DIFFUSION OF SOME ISOTOPES OF Xe. Saviron, J. M.; Gonzalez, D.; Madariaga, J. A.; Quintanilla, M. Translated for Mound Lab., Miamisburg, Ohio, from An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 83-90(1967). 17p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 28065. (P.C.H.)

25472 (ORNL-tr-1765) AT 1: LINK IN THE FRENCH FAST BREEDER SERIES RESEARCH PROGRAM. Amaury, Paul; Talmont, Xavier. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Energ. Nucl. (Paris), 9: 113-19(Mar.-Apr. 1967). 20p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 27835. (P.C.H.)

25473 REPROCESSING INSTALLATION AT KARLSRUHE: CONSTRUCTION, MODE OF OPERATION, AND OBJECT-IN VIEW. Huppert, Karl-Ludwig (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH, Karlsruhe, Ger.). At. Strom., 14: 9-12(Jan. 1968). (In German).

The development of a part of a section for the fuel cycle for nuclear fuels is described. The installation described is to be used to gain experience with a tried and tested technology, and to further develop it. (auth)

25474 ION EXCHANGE SEPARATION OF SOME RARE EARTHS AND ACTINIDES UNDER OPTIMUM CONDITIONS WITH α-HYDROXYISOBUTYRIC ACID. Hoehlein, G.; Born, H. -J. (Technische Hochschule Munich, Garching, Ger.). Radiochim. Acta, 8: 172-5(Dec. 1967).

In order to find optimum conditions for actinide and lanthanide separations on Dowex 50WX12 with α-hydroxyisobutyric acid as eluant the influence of p_H on α-hydroxyisobutyrate activity was investigated. By means of p_H gradient elution rare earths in trace and mg amounts were completely separated from each other. This technique allows separation of trace amounts of ^{242}Cm from mg amounts of neutron-irradiated ^{241}Am in the presence of some fission products. (auth)

25475 SEPARATION OF TELLURIUM NUCLEAR ISOMERS IN DIMETHYLTELLURIUM DIIODIDE AND DIMETHYLTELLURIUM PICRATE. Carrillo, Lila; Nassiff, S. J. (Instituto de Asuntos Nucleares, Bogota). Radiochim. Acta, 8: 124-7(Dec. 1967).

The separation of the nuclear isomers $^{127m}/^{127g}Te$ and $^{129m}/^{129g}Te$ previously bound to dimethyltellurium diiodide and dimethyltellurium picrate, in which the tellurium was in the tetravalent form was studied. A separation yield of 94.5 ± 3.5% and 61.4 ± 1.1% for $^{127m}/^{127g}Te$ and $^{129m}/^{129g}Te$, respectively, was found in the dimethyltellurium diiodide. In the dimethyltellurium picrate, the yield was 93.4 ± 3.4% for $^{127m}/^{127g}Te$ and 64.5 ± 4% for $^{129m}/^{129g}Te$. The tellurium isomers in ground state were isolated carrier free. (auth)

25476 BEHAVIOR OF PRODUCTS OF IRRADIATION IN THE HIGH-TEMPERATURE TREATMENT OF NEUTRON-IRRADIATED URANIUM DIOXIDE. Lux, Franz; Graw, Dieter; Vogel, Joerg (Technische Hochschule, Munich). Radiochim. Acta, 8: 132-42(Dec. 1967). (In German).

Earlier investigations, carried out to study the behavior of fission products and transuranium elements in heterogeneous reactions between neutron-irradiated uranium compounds and gaseous or liquid phases containing a complexing agent, were extended to reactions between solid uranium compounds and other solid phases. The experiments were done under argon in a Tammann furnace. The starting material was neutron-irradiated UO_2. The material of the crucible (graphite or Al_2O_3) acted as the other solid phase. In reactions occurring between 1140 and 1880°C the elements Sr, Ba, Te, Mo, and Ru were separated quantitatively; in the same temperature range the elements Nd, Ce, and La were partly separated (38-74%). The separation of the fission products depends specifically on the material of the crucible. This effect is explained by "microscopic heterogeneous solid-state reactions" between the fission products and the material of the crucible; these reactions are thought to cause a volatilization of the fission products in elementary or oxide form. The results are discussed in view of a possible application to reprocessing of spent fuel elements. (auth)

25477 ^{226}Ra LIBERATION FROM URANIUM ORE PROCESSING MILL WASTE SOLIDS AND URANIUM ROCKS INTO SURFACE STREAMS. I. THE EFFECT OF DIFFERENT pH OF SURFACE WATERS. Havlik, Borivoj; Grafova, Jaroslava; Nycova, Bedriska (Inst. of Hygiene, Prague). Health Phys., 14: 417-22(May 1968).

Intensive uranium ore mining and processing cause increasing contamination of surface waters with natural radioactivity, often over large areas. Most of the radioactive wastes penetrating into surface waters (mine waters, effluents from uranium ore processing mills, wash down from dumps and overburdens) contain radioactive isotopes bound to sedimenting matter. The results are presented of experimental studies of the dependence of radium release from ores and sediments on hydrogen ion concentration in surface waters. Dried homogenized samples of uranium ore and sediments containing ^{226}Ra to 14 pCi/g, 84 pCi/g, and 540 pCi/g were shaken for 15, 30, 60, 180, 300, and 480 min with water of pH in the range of 1 to 13. A maximum amount of radium was leached in 15 to 30 min of shaking when pH was 1 (22%). With increasing pH the amount of released radium decreased (to pH 9). (auth) (UK)

25478 ^{226}Ra LIBERATION FROM URANIUM ORE PROCESSING MILL WASTE SOLIDS AND URANIUM ROCKS INTO SURFACE STREAMS. II. THE EFFECT OF DIFFERENT CHEMICAL COMPOSITION OF SURFACE WATER. Havlik, Borivoj; Nycova, Bedriska; Grafova, Jaroslava (Inst. of Hygiene, Prague). Health Phys., 14: 423-30(May 1968).

Surface water contaminated by radioactive waste from uranium ore mining and processing showed higher concentrations of dissolved radium in places several kilometers from the place of outlet of the wastes than in the outlet itself. The influence of inorganic salt concentrations was studied. Homogenized and dried samples of uranium ores and sediments were shaken with distilled water together with 1 N, 0.1 N, and 0.01 N concentrations of $BaCl_2$, $SrCl_2$, $MgCl_2$, $CaCl_2$, LiCl, NaCl, KCl, $(NH_4)_2SO_4$, Na_3PO_4, K_3PO_4, and $MgCO_3$ salts. It was found that 95 to 100% of radium bound in sediments was released in 1 N solutions of KCl and NaCl dependent on the structure and mineralogical composition of the sediment. A positive effect on the leachability of radium was also shown by $CaCl_2$ solution. (auth) (UK)

25479 QUANTITATIVE SEPARATION OF BARIUM FROM STRONTIUM AND OTHER ELEMENTS BY CATION EXCHANGE CHROMATOGRAPHY IN HYDROCHLORIC ACID–ORGANIC SOLVENT ELUENTS. Strelow, F. W. E. (National Chemical Research Lab., Pretoria). Anal. Chem., 40: 928-31(May 1968).

Cation exchange distribution coefficients for Ba and Sr in mixtures of HCl with the organic solvents methanol, ethanol, acetone, and dioxane are presented with AG50W-X8 and AG50W-X12 resins. A method for the quantitative separation of Ba from Sr and other elements is described. Sr is eluted from a column of 60 ml AG50W-X8 resin of 200- to 400-mesh particle size by 3.0 M HCl containing 20% ethanol at a flow rate of 2.5 ± 0.3 ml per minute. Ba is retained by the column and can be eluted with 3M HNO_3. Al, Ca, Mg, Fe(III), Ti(IV), Mn(II), Cu(II), Co(II), Ni(II), Zn, Cd, U(VI), Ga, In, Pb(II), and most other elements accompany Sr quantitatively. Zr, Hf, and Th accompany Ba, but are retained by the column when Ba is eluted with 2M HNO_3. The rare earths interfere and have to be removed by an extra separation step. An elution curve for the favored eluent concentration and results on quantitative separations of synthetic mixtures are included. (auth)

25480 SEPARATION OF MILLIGRAM QUANTITIES OF AMERICIUM AND CURIUM BY EXTRACTION CHROMATOGRAPHY. Horwitz, E. P.; Bloomquist, C. A. A.; Orlandini, K. A.; Henderson, D. J. (Argonne National Lab., Ill.). Radiochim. Acta, 8: 127-32(Dec. 1967).

The separation of milligram quantities of americium and curium was carried out by extraction chromatography using a high-molecular-weight quaternary ammonium nitrate (Aliquat-336 nitrate) absorbed by hydrophobic diatomaceous earth. $LiNO_3$ solution was used as the elutriant. The method was particularly advantageous for obtaining curium highly decontaminated from americium (<60 ppM Am) and was applied to the purification of 10 Ci of ^{242}Cm. Complete separations were achieved in two hours operating at room temperature. Preliminary studies of the ef-

fect of capacity of the column material on column performance and the effect of nitrate normality on the separation factor, Am(III)/Cm(III), were also carried out. (auth)

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different temperatures. The apparatus consists of two exchange columns, one operated at low temperature, the other one at high temperature, and one separation column. The enriched mixture enters the separation column at the top and is taken out as vapor in the bottom. The dissolved H_2S is removed at the top of the same column and dissolved salts together with H_2O at the bottom. Both the enriched product and the H_2S are refluxed through the exchange columns. (Swed)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 25445, 25446, 25477, 25478, 25614, 25684, and 25828.

25491 (BNWL-481-3) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1966 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME II, PHYSICAL SCIENCES. PART 3, EARTH SCIENCES. Pearce, D. W.; Compton, M. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1968. Contract AT(45-1)-1830. 104p. Dep. CFSTI.

Separate abstracts were prepared for each of the twenty-two sections on the Battelle-Northwest, Pacific Northwest Laboratory research programs in the earth sciences and in aerosol studies. (L.C.L.)

For abstracts of individual sections see: 25445–25448, 25492–25501, 25565–25568, and 25604–25607.

25492 (BNWL-481-3, pp 1-2) YAKIMA BASALT FORMATION AND ITS RELATIONSHIPS TO THE COLUMBIA RIVER IN AQUIFER DEVELOPMENT. Brown, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Determination of the extent and distribution of individual basalt flows and associated sedimentary interbeds in the Pasco Basin and environs has indicated regional relations from which the nature and extent of individual aquifers can be identified and ultimately their areas of recharge and discharge, their interconnections, and their productive capacity. This information will better permit the disposal or storage of radioactive wastes in the ground at points minimizing possible contamination of aquifers. In addition it will assist in procurement of water for sanitary and irrigation supplies in areas external to the Hanford Project. (auth)

25493 (BNWL-481-3, pp 3-5) INCIDENCE OF EARTHQUAKES AT HANFORD AS DEDUCED FROM GEOLOGICAL FEATURES. Brown, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The geologic features of the Hanford, Washington area were examined to determine the incidence of earthquakes. These examinations indicate that there has been little fault movement in the last 10,000 years. (L.C.L.)

25494 (BNWL-481-3, pp 5-10) GEOPHYSICAL SEISMIC EXPLORATION. Raymond, J. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The refraction seismic method was used to locate the basalt formations in the Hanford, Wash. area. The basalt bedrock provides the lower boundary for the ground water table and as such is an important parameter in the evaluation of the area hydrology. The method and equipment are described. The results indicate that this method provides an easy and relatively fast method of acquiring additional geologic and hydrologic information on the Hanford Project. The method will provide accurate information of basalt depth and configuration. (L.C.L.)

25495 (BNWL-481-3, pp 10-14) BOUGUER GRAVITY ANOMALIES ON THE HANFORD RESERVATION. Peterson, D. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A recent survey indicates that the earth's gravity field ranges from 980.4786 to 980.7120 gal (cm/sec^2) within the Hanford Reservation. Regional and local density variations in the earth's rigid crust are delineated by Bouguer gravity anomalies. The regional Bouguer gravity of –50 milligal is situated in the Pasco Basin. This gravity high supports geologic evidence which suggests that the Pasco Basin contains the largest accumulation of basalt flows in the Columbia Plateau. (auth)

25496 (BNWL-481-3, pp 15-17) NUMERICAL EXPERIMENTATION FOR OBTAINING ACCELERATION FACTORS IN FINITE DIFFERENCE SOLUTIONS TO FLOW OF FLUIDS THROUGH SOILS. King, L. G.; Reisenauer, A. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Numerical experimentation to obtain acceleration factors for use in finite difference solutions to the flow of fluids through soils is considered to be unwarranted unless a large group of similar problems must be solved to which one best factor might apply. It is recommended that, for economy of solution, the acceleration factor be chosen by experience. (L.C.L.)

25497 (BNWL-481-3, pp 18-23) AN APPLICATION OF A HANFORD DEVELOPED DIGITAL COMPUTER PROGRAM IN PREDICTING CHANGES IN WATER TABLE ELEVATIONS. Cearlock, D. B.; Nelson, R. W.; Reisenauer, A. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The effects on the Hanford ground water table resulting from irrigation of 35,000 acres of land on Rattlesnake Mountain slope were predicted by use of the Hanford-developed computer program, "Steady." The appropriate boundary value problem describing two-dimensional flow was established by inputing the best field data available combined with the flow expected from irrigation. Figures showing the ground water table before and after irrigation are included. (auth)

25498 (BNWL-481-3, pp 23-8) FUNCTIONAL REPRESENTATION OF FLOW SYSTEM SURFACES. Cearlock, D. B.; Friedrichs, D. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The digital computer program GENORO was used to perform functional fitting of Hanford field data on ground water location, and, thereby to develop an accurate mathematical representation of the multidimensional ground water flow system. (L.C.L.)

25499 (BNWL-481-3, pp 28-34) IN-PLACE DETERMINATION OF PERMEABILITY DISTRIBUTION FOR HETEROGENEOUS POROUS MEDIA THROUGH ANALYSIS OF ENERGY DISSIPATION. Nelson, R. William (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Although most engineering problems of flow through porous media involve heterogeneous rather than homogeneous media, the analysis of heterogeneous systems has been limited by a lack of accurate and economical methods for measuring field permeability distributions. A method for making permeability measurements by analyzing energy dissipation has been developed in which the potential energy distribution throughout a natural flow system provides input data for two main computer programs that generate and solve equations yielding the field permeability distribution. The techniques developed and the computer software required are described, and the method is demonstrated in a field application. (auth)

25500 (BNWL-481-3, pp 34-8) TRANSPORT ANALYSIS: BASIC PREDICTIVE APPROACH TO THE MOVEMENT OF POLLUTANTS THROUGH SOILS. Cearlock, D. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An accurate knowledge of the concentration distribution of pollutants in a ground water system is an essential element in effective waste disposal management where effluents are discharged to the ground. A transport equation was developed with which concentration distributions of pollutants in a groundwater flow system can be determined. With this equation the two main independent phenomena which affect the transport of pollutants through soils, fluid movement and pollutant reactions, are combined into one interrelated equation which yields the concentration distribution of the pollutants involved, and permits the separate investigation of the reaction aspect of transport analysis independent of the flow aspects. (L.C.L.)

25501 (BNWL-481-3, pp 39-42) DISPERSION CHARACTERISTICS OF STRONTIUM IN SOIL COLUMNS: PARTIALLY SATURATED TRANSIENT FLOW. Hajek, B. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An experiment for determining the migration and dispersion characteristics of strontium ions invading soil in two partially saturated transient systems is described. Porous soil was packed into a tray and a solution of 0.1 $\underline{N}$ $Sr(NO_3)_2$ traced with ^{85}Sr introduced. The quantity of wetting solution and position of the wetting front were recorded, the flow stopped, and the soil samples analyzed for moisture and strontium content. It was concluded that no model could be successfully used to predict Sr dispersion in soils, and that the solution flow rate had little effect on the Sr dispersion at equivalent distances migrated. (L.C.L.)

25502 (NP-17345) GEOLOGIA DEL YACIMIENTO URANIFERO DE EL MEZQUITE, MUNICIPIO DE RODEO, ESTADO DE DURANGO. (Geology of the Uranium Bearing Deposit of the Mesquite, Town of Rodeo, State of Durango). Hokuto Castillo, Alfonso (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria). 1967. 123p. (In Spanish). Dep. Thesis.

The study of the geology of the uranium-bearing deposits of the

Mesquite showed that the mineralization of uranium is principally in two species, autumite and uranofane. The geology and stratigraphy of the region were analyzed. The geological history was outlined. The methods of exploration are outlined. An economic evaluation was made of the ore deposits. (J.S.R.)

25503 ON THE ADSORPTION OF RADON ON ACTIVATED CARBON. Kapitanov, Yu. T.; Pavlov, I. V.; Semikin, N. P.; Serdyukova, A. S. Izv. Vyssh. Ucheb. Zaved., Geol. Razved., No. 7, 118-25. (In Russian).

The ability of activated carbon to adsorb radon is variable. In air having 100 percent relative humidity, the equilibrium coefficient of distribution of activated carbon with respect to radon is about half as much as in dry air. As the air pulled through the adsorbent cools, the adsorption capability increases sharply; for SKT 2M carbon (which shows the maximum equilibrium coefficient, 9,650 cm^3/g at 18°C in dry air) the equilibrium coefficient reaches 10^6 cm^3/g at 60°C. (Geophys. Abstr.)

25504 STRONTIUM ISOTOPE RATIOS IN VOLCANIC ROCKS OF THREE ISLAND ARC AREAS. Pushkar, Paul (Algoma Coll., Sault St. Marie, Ontario, Can.). J. Geophys. Res., 73: 2701-14(Apr. 15, 1968).

The initial $^{87}Sr/^{86}Sr$ ratios in several non-ignimbrite calc-alkaline volcanic rocks from Saipan, Central America, and the Lesser Antilles, with two exceptions, lie in the range 0.703 to 0.705 (average very close to 0.704). Such isotope ratios are characteristic of most young volcanic rocks. Similar ratios are found in several tholeiitic lavas in the northern Mariana, the Bonin, and the Izu islands as well. This suggests that all these lavas are formed in a source area in the upper mantle or possibly in basaltic rocks of the oceanic crust and lower continental crust. Formation of the calc-alkaline series by contamination of such magmas with continental material is not required by the isotope evidence, but it may take place to the extent that the contaminating radiogenic strontium in the continental material can be diluted beyond detection by magmatic strontium. The calc-alkaline series of Nuclear Central America cannot form by direct melting of the underlying continental rocks. Two lavas in the Lesser Antilles were erupted with initial $^{87}Sr/^{86}Sr$ ratios markedly greater than 0.704. It is suggested that the Puerto Rico trough became filled with sedimentary material composed of authigenic carbonate-rich material and continental detritus deposited by the Orinoco River. This material was then buckled to form the Barbados ridge, possibly by convective currents in the upper mantle, and some of it became incorporated in magma chambers. (auth)

25505 DETERMINATION OF RATE CONSTANTS OF ^{238}U SPONTANEOUS FISSION ACCORDING TO XENON ACCUMULATION IN MINERALS. Shukolyukov, Yu. A.; Ashkinadze, G. Sh.; Levchenkov, O. A.; Ovchinnikova, G. V. (Inst. of Precambrian Geology and Geochronology, Leningrad). Geokhimiya, No. 3, 265-74(Mar. 1968). (In Russian).

The value of the rate constant of uranium-238 spontaneous fission was determined by the geochemical method according to the measured concentrations of uranium and xenon in uranium-containing minerals and to their age by data of the uranium-lead method. The uranium and xenon concentrations in the investigated minerals were determined by the mass-spectrometric method using the most reliable technique of isotope dilution. The isotopic analysis of xenon permitted to exclude its share conditioned by the neutron-induced fission of uranium-235 nuclei. The absolute yield of xenon isotopes in the spontaneous uranium-238 fission was estimated. For the group of minerals which had at most preserved the radiogenic xenon, the λ_f value was $(10.3 \pm 0.5) \times 10^{-17}$ $year^{-1}$ which is in agreement with the results of ionization measurements. (auth)

25506 HEAVY RADIOACTIVE ELEMENTS IN VOLCANOGENIC PROCESSES. Cherdyntsev, V. V.; Zverev, V. L.; Kislitsyna, G. I. Izv. Akad. Nauk SSSR, Ser. Geol., No. 4, 17-25(1967). (In Russian).

The existence of fractionation of U and Th isotopes in volcanic processes is demonstrated. Sometimes (in the early stages of volcanism) there is relative depletion of the magma in ^{234}U, and in the case of active fumarolic activity an enrichment of volcanogenic rocks in that isotope. Fumarole deposits have a high ionium content compared with thorium. Frequently an extremely low Th–U ratio is observed for these deposits. The removal of radioactive elements by exhalation processes is accomplished in the order Fe > U > Ra > Th. Sometimes plutonium is enriched relative to uranium. Investigations of the heavy elements evidently could provide the key to an understanding of the evolution of magma chambers. (Geophys. Abstr.)

25507 INTERPRETATION OF THE METHOD OF GAMMA-RAY SCATTERING. Hradil, Josef. Sb. Geol. Ved Uzita Geofyz., No. 6, 95-124(1967). (In Czech).

Some problems of interpretation of curves of the density modification of the gamma scattering logging method are considered. The shape of the curve is determined for an interface between layers of different density, using once-scattered gamma radiation. The shape found is approximately expressed through the cosine function, which makes it possible to plot the theoretical shapes of curves for the individual layer for different rates of measurement, time constants, and effective sonde length. Nomographs based on these shapes are presented for interpreting thicknesses and correcting the anomalies; their use is illustrated by examples. Factors leading to inaccuracies in interpretation of thin layers are also analyzed. (Geophys. Abstr.)

25508 INVESTIGATION OF GROUND WATER RADIAL FLOW USING RADIOACTIVE TRACERS. Hazzaa, I. B.; Girgis, R. K.; Saad, K. F.; Swailem, F. M.; Bakr, A. A. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo). Int. Ass. Sci. Hydrol. Bull., 12: 55-9(Sept. 1967).

A study of the effectiveness of various radioisotopes in revealing the porosity of water-bearing formations, with ^{131}I, ^{51}Cr-EDTA, and ^{82}Br, in comparison with ^3H_2O, showed that ^{131}I was most useful for this purpose. Field experiments were conducted to study the effective porosity of the ground water aquifer, by injecting ^{131}I simultaneously with ^3H_2O as a reference, at different depths, to examine the influence of the depth of injection of the radioisotopes on the values obtained for the effective porosity of the aquifer under pumping conditions. A pumped well, fully penetrating a homogeneous sandy aquifer, was chosen. Three runs were undertaken injecting the radioisotopes in a 10-m distant observation well at 3 different levels. An additional run was made by injecting ^{131}I at the 3 depths simultaneously. In each run, the activity of the outflowing water was followed until it reached the background level. The results indicated that the values obtained for the effective porosity of ground water aquifer using tracers are not dependent on the depth of injection of the tracer. This conclusion holds for radial flow, in homogeneous aquifers, between the observation well and the pumped well. The percentage recovery of the injected activity was calculated. (BBB)

25509 NATURAL RADIOELEMENTS IN SURFACE AND SOIL–SUBSOIL WATERS. Baranov, V. I.; Morozova, N. G.; Akimova, T. G.; Orlova, A. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 3, 334-41(Mar. 1968). (In Russian).

Data on the radium, uranium and thorium content in soil-subsoil waters, lake and river waters of the Estonian Soviet Socialist Republic are given. It is shown that the Ra-content changes in the ranges of $n \times 10^{-14}$ to $n \times 10^{-13}$ g/l, $U-n \times 10^{-7}$ to $n \times 10^{-6}$ g/l and $Th-n \times 10^{-8}$ to $n \times 10^{-7}$ g/l. In all types of surface waters equilibrium between U and Ra is lacking. In soil-subsoil waters, lake and river waters the equilibrium is displaced towards U dominance over Ra. In the same type of waters radium makes up 20 to 50% of the equilibrium amount with uranium being contained. In lysimetric soil waters and acid waters of low-land bogs Ra in present in an amount considerably exceeding the equilibrium amount with contained uranium. In surface waters of all types the Th : U ratio $\ll$ I (with an average value from 0.1 to 0.4). (auth)

25510 OVERALL REPRESENTATIVENESS OF THE MEASUREMENTS IN THE DETERMINATION OF DENSITY BY THE GAMMA METHOD. Artsybashev, V. A.; Popov, E. P. Zap. Leningrad. Gorn. Inst., 51: 125-32(1966). (In Russian).

Additional experimental data are given on depth of penetration, an attempt is made to systematize the accumulated information, and results are presented of a study of the representativeness of different parts of the medium adjacent to the sonde in density determination by the method of scattered gamma radiation. (Geophys. Abstr.)

25511 SOIL WATER MEASUREMENT WITH A ^{241}Am–Be NEUTRON SOURCE AND AN APPLICATION TO EVAPORIMETRY. Van Bavel, C. H. M.; Stirk, G. B. (Water Conservation Lab., Phoenix, Ariz.). J. Hydrol., 5: 40-6(Mar. 1967).

The usefulness of the neutron method for measuring soil water content was enhanced by use of a γ-free, ^{241}Am-Be fast-neutron source with a long half-life. Source strength was materially increased, and weight of probe and accessories decreased, the former contributing to greater precision and the latter to convenience in use. Many field observations were made under typical operating conditions, demonstrating the actual performance with regard to precision of water content measurement. Weight of the probe was about 1 kg. No shield was employed and no significant

neutron exposure was recorded by standard film badges. Thin-walled aluminum access tubes with a 5-cm OD were used. All counts were expressed as a ratio to the count in a water standard. In an infinite environment of water, the observed count rate was 1.63×10^5 cpm, implying a significant coincidence loss since the experimentally determined resolution time of the scaler was 1.60×10^{-6} min. All counts were corrected accordingly and the corrected count in water became 2.06×10^5 cpm (about 13 to 16 times larger than the corresponding value for the usual equipment using Ra–Be sources). The use of the 150-mCi ^{241}Am-Be source described gave several significant advantages, including elimination of the γ radiation and attendant health hazard, reduction in weight, increased counting rate, and an apparently increased depth resolution. Soil water inventories at one site to a depth of 170 cm could be obtained with a precision of ~0.1 cm of water. The suggestion was made that improved neutron logging be combined with a suction-type percolation lysimeter to obtain short-term amounts of evaporation without a weighing mechanism. (BBB)

25512 THE GEOCHEMISTRY OF SURFACE WATERS OF THE WESTERN DISTRICT OF VICTORIA. Maddocks, G. E. (Univ. of Melbourne). Aust. J. Mar. Freshwater Res., 18: 35-52(June 1967).

Strontium content was compared with levels of other constituents (Na, K, Mg, Ca, Cl, Br, SO_4, CO_3 B, Si, P, and N) in some lakes and rivers of the Western District of Victoria (Australia). All these waters are of the Cl type and Na is the dominant cation. Comparatively high pH values are common. Several ionic ratios were calculated and used to illustrate relative enrichments or losses among the ions present during an overall increase in total salinity. Precipitation of dolomitic carbonate is indicated. The similarity of several ionic ratios to those of sea water is used to propose an oceanic origin for these inorganic constituents. Clay membrane mechanisms coupled with solar evaporation are suggested as an explanation for the extreme salinity range of samples. The observed Ca : Sr ratios support the hypothesis of $CaCO_3$ precipitation. Partition coefficient data show that Sr is enriched relative to Ca in a solution precipitating calcite or aragonite. This is seen in the lake waters as a decrease in the Ca : Sr ratios with increasing total salinity (TS). The Na : Sr ratios show that Sr is being lost as TS increases so that partition of Sr between a Ca-rich precipitate and the water can be implied. (BBB)

25513 DETERMINATION OF THE DENSITY OF ROCKS BY THE SCINTILLATION COUNTER BY MEANS OF THE METHOD OF γ ABSORPTION OF A SMALL RADIATION BEAM. Volker, A. R. (Karl-Marx-Univ., Leipzig). Geophys. Geol. (Leipzig), 7: 84-95(1965). (In German).

The density and moisture content of rock formations and soils was measured by γ absorption and collimation procedures. The measurement error amounted to ~1%, and measurement times to from 6 to 10 min/sample. The advantages of modern radiometric methods for in situ moisture and density measurements are that the naturally occurring physical relations of the strata are undisturbed by the insertion of the probe, a wide area or volume can be measured readily if the proper measurement adjustments are taken into account, the measurement time is only ~5 min, the number of samples required can be minimized by proper localization of the probe, and other equally important geologic characteristics such as porosity, density, and rock structure may be readily calculated from the moisture and density measurements. The number of personnel required is two, at most. The significance and possibilities of methods and procedures are described and discussed in detail. (BBB)

25514 FORMATION RATE OF COSMOGENIC ISOTOPES IN IRON METEORITES. Lavrukhina, A. K.; Revina, L. D.; Yukina, L. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 3, 251-64(Mar. 1968). (In Russian).

The formation rate of radioactive isotopes, ^{22}Na, ^{36}Cl, ^{49}V, ^{54}Mn and of the accumulation of the stable isotope ^{38}Ar for 1 million years in iron meteorites of spherical shape and a radius R = 2.5 to 200 cm was calculated. The role of different components of nuclear-active particles in the formation of cosmogenic isotopes has been estimated. The results obtained on the formation rate of cosmogenic isotopes were compared with calculated experimental data in the literature. (auth)

25515 FIXATION OF RADIOACTIVE WASTES IN CEMENT. Schejbalova, Ludmila (Inst. of Nuclear Research, Rez, Czechoslovakia); Novotny, Jiri. Tech. Dig. (Prague), 9: 531-6(Aug. 1967).

Studies were carried out to find a composition of concrete that would ensure both the degree of strength needed for safe transport, and a highly efficient fixation of the radioactive materials. Comparative studies proved the advantages of Portland cement. Data are presented in tables and graphs. Other cements were better than Portland cement at retaining the radioactivity but their volume stability after long aging times was not sufficient to permit their practical use. (M.C.G.)

25516 ^{239}Pu IN NATURE. Cherdyntsev, V. V.; Zverev, V. L.; Kuptsov, V. M.; Kislitsina, G. I. (Geological Inst., Moscow). Geokhimiya, No. 4, 395-401(Apr. 1968). (In Russian).

The content of ^{239}Pu, the product of decay of the transuranium isotope (probably ^{247}Cm) with 4.4 to 4.6 MeV energy, was investigated in various natural formations. In a number of cases preparations of the transuranium isotope were investigated. The best results were obtained by sublimation from nitrate solutions. By its chemical properties the isotope most closely approaches osmium. In ferruginous–manganese deposits of recent volcanism the content of plutonium reaches 7.4×10^{-10}%, in neovolcanic rocks 3.9×10^{-11}%, in manganese concretions of the ocean 6×10^{-11}%, and in meteorites 3.5×10^{-12}% when the Pu/U ratios are 1.7×10^{-5}, 1.8×10^{-6}, 5.5×10^{-8}, 1.25×10^{-6}, respectively. The geochemical features of plutonium behavior are considered. (auth)

25517 NEW EXPERIMENTAL AND CALCULATED DATA ON THORIUM MIGRATION UNDER HYPERGENIC CONDITIONS. Drozdovskaya, A. A.; Mel'nik, Yu. P. (Inst. of Geological Sciences, Kiev). Geokhimiya, No. 4, 402-10(Apr. 1968). (In Russian).

Forms of thorium migration in different kinds of natural waters in the hypergenesis zone are considered. From published experimental data the free energy values of the formation of thorium compounds under standard conditions were calculated. By the thermodynamic method the stability fields of thorium compounds were determined. It was established that thorium can migrate in "pure" hypergenic waters in the following forms: Th^{4+}, $ThOH^{3+}$, $Th(OH)_2^{2+}$, $Th(OH)_3^{+}$, $Th(OH)_4^{0}$, and $Th_6(OH)_{15}^{9+}$, and in sulfate waters in the forms $ThSO_4^{2+}$ and $Th(SO_4)_2^{0}$. (auth)

25518 RECENT ADVANCES IN THE APPLICATION AND INTERPRETATION OF RADIOMETRIC AGE DATA. Moorbath, S. (Oxford Univ.). Earth-Sci. Rev., 3: 111-35(June 1967).

Fundamental aspects of radiometric dating of minerals and rocks are reviewed. The basic precept examined is that for igneous and metamorphic rocks, which have had a simple history since the time of crystallization, analytical dates represent the time when the temperature of the system passed a threshold value, above which atoms of radiogenic daughter nuclides were able to diffuse quantitatively out of their host mineral or rock, but below which they were quantitatively retained. In deep-seated igneous and metamorphic terrains there may be a significant time-lag between crystallization and termination of a diffusion episode. Methods described include those for Rb/Sr on whole rocks, U/Pb on zircons and K/Ar and Rb/Sr on certain types of minerals other than fine-grained micas. The different types of concordant and discordant mineral and whole-rock radiometric age patterns produced in terrains with a simple cooling history and in those which have been subjected to more than one thermal episode are reviewed, and the true geological significance, if any, of radiometric dates obtained on different types of minerals and whole rocks by the various age methods, as well as the validity of histograms in geochronology are discussed. Several published geochronological case histories are described which illustrate these principles. (BBB)

25519 EVALUATION OF GAMMA LOGS FROM BORE SAMPLES WITH THE AID OF SMALL COMPUTERS. Harmann, Lothar; Henkel, Wolfgang. Z. Angew. Geol., 13: 212-17(Apr. 1967). (In German).

A numerical method which permits use of a small computer for evaluation of γ activities in ore bore samples is described. The radiometric method described takes into account the sp act., mass absorption coefficients, volume elements, source measurement distances for various layers of ore, etc., and yields by integration procedures the total radioactivity of any given layer. The parameters that are required are described in detail, and the elements of the matrices used are discussed. The schematic flow diagram that is used as a basis for the computer program is given. The logic of the program is described and discussed. Samples of preprinted edge punch cards that are used for recording results of the measurements and computations are illustrated. Methods for establishing the accuracy of the measurements by comparison of repeated control studies are included in the program. Efficiency of the measurement operation has been increased by ~300% over other methods. However, there is still considerable possibility for increased rationalization of this type of measurement by increased use of automatic data processing procedures or on-site, continuous measurements. (BBB)

25520 NATURAL RADIOACTIVITY OF SOIL-FORMING ROCKS IN THE MIDDLE VOLGA REGION. Vaysberg, B. I.; Smirnov, V. N. Dokl. Soil Sci. (Engl. Trans.), Suppl. 13, 1492-4(June 1967).

Since soil-forming rocks play an important role in the radioactivity of soils and groundwater circulating in various rocks, a study was made of the natural radioactivity of some soil-forming rocks taken from deep soil horizons in the Mari and Chuvash USSR. Also investigated were nonsodded freshly deposited alluvial sand of the Volga River from near the city of Kozmodem'yansk. For comparison, potassium-rich glauconite sand from Bryansk Oblast was examined. Old alluvial sands had the least natural radioactivity (0.25 to 1.25×10^{-12} Ci/g). Nonsodded, freshly deposited Volga sand, which has a more finely grained texture and is apparently richer in mineralogical composition, had a higher radioactivity (5 to 10×10^{-12} Ci/g) than the old alluvial deposit. Permian sands are much more radioactive than Quaternary sands. The radioactivity of the cinnamon-brown Permian sand approached that of glauconite sand (11.75×10^{-12} Ci/g), which is rich in potassium and probably also in the ^{40}K isotope. Clay loams had a higher radioactivity (14×10^{-12} Ci/g) and Permian rocks, which are richer in chemical composition, and were more active than the mantle rocks. But loess-like clay loams had the highest radioactivity (16×10^{-12} Ci/g). Consequently, in this respect they exceed in radioactivity the mantle formations of the Central Volga region that are genetically similar to them. (BBB)

25521 HEAT FLOW AND SURFACE RADIOACTIVITY MEASUREMENTS IN THE PRECAMBRIAN SHIELD OF WESTERN AUSTRALIA. Hyndman, R. D.; Lambert, I. B.; Heier, K. S.; Jaeger, J. C.; Ringwood, A. E. (Australian National Univ., Canberra). Phys. Earth Planet. Interiors, 1: 129-35(Jan. . 1968).

A borehole for heat flow measurement was drilled in a region of high radioactivity granitic rocks in the Archaean shield of Western Australia. Most previous shield heat flow determinations have been in low radioactivity basic and ultrabasic rocks which constitute less than 20% of the shield surface rocks. The heat flow of 1.23 μcal/cm^2 sec measured in the granitic rocks is significantly higher than most previous shield values but is still much lower than the heat flows measured in the younger areas of eastern Australia. Two new measurements on the shield in basic and ultrabasic rocks give heat flows of 0.82 and 0.69. The mean surface radioactive element heat production in the Western Australian shield is found to be similar to that of the high heat flow regions of eastern Australia. This suggests that the radioactivity is concentrated in a very thin surface layer in the shield crust. The high radioactivity surface layer is probably largely absent in shield regions of basic and ultrabasic rocks where very low heat flows have been measured. Crustal radioactive element and temperature profiles have been estimated for the shield and for a high heat flow area. (auth)

25522 RADIOACTIVITY AND EARTH HISTORY. von Buttlar, Haro (Ruhr-Univ., Bochum, Ber.). Bild Wiss., 4: 902-11(Nov. 1967). (In German).

The use of ^3H, ^{14}C, ^{40}Ar, ^{40}K, ^{87}Sr, ^{87}Rb, ^{207}Pb, ^{208}Pb, ^{232}Th, and ^{235}U to measure the age of archaeological, geological, and geochemical materials is reviewed. Following an exposition of the methods and theory, the dating of sediments by measurement of ^{40}K and ^{40}Ar to establish transitional stages from Australopithecus man to homo sapiens of $\frac{1}{2}$ to 1 million yr ago and to date the end of Neanderthal civilization and development of homo sapiens 35,000 to 40,000 yr ago is discussed. The recession of the last ice age has been dated at 11,000 yr ago, followed by population of North America by humans at approximately the same time. Radioactivity dating of human artifacts (such as roof tiles from Mesopotamia), population migrations, and dating of the Mayan calendar is mentioned. Applications of radioactivity dating to atmosphere and hydrological problems, and to dating of wines are discussed. The possibility of interference with radioactivity dating procedures from nuclear explosion tests is discussed. (BBB)

Meteorology

Refer also to abstracts 25491, 25555, and 25580.

25523 (BNWL-SA-1739) MEASUREMENT AND BEHAVIOR OF AIRBORNE RADIONUCLIDES SINCE 1962. Thomas, C. W.; Young, J. A.; Wogman, N. A.; Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1, 1968. Contract AT(45-1)-1830. 18p. (CONF-680308-9). Dep. CFSTI.

From 155th National Meeting of the American Chemical Society, San Francisco, Calif.

Studies of airborne radioactivity at different latitudes since 1962 have shown that a great deal can be learned about tropospheric and stratospheric mixing processes from ground-level air measurements. The concentrations of some 20 radionuclides were measured for a period of six years at Richland, Washington and shorter periods at Point Barrow, Alaska and Rio de Janeiro, Brazil. The long lived fission products show a different annual deposition rate than the natural cosmic ray-produced ^7Be. From these measurements an apparent stratospheric half residence time of 11.8 months at 46°N Lat and of 13 months at 71°N Lat was observed. In addition, these data have shown the annual peak in the ground-level air concentration arrives 3 to 4 months earlier at 71°N than at 46°N. Also, cosmic ray-produced ^7Be attains a maximum before the bomb produced radionuclides at 71°N and later than the bomb produced isotopes at 46°N. The radionuclide concentrations in ground-level air are about twice as high at 46°N as at 71°N. The rate of increase toward the annual peak concentration for all radionuclides at both 46°N and at 71°N can be approximated by an exponential in which the concentration doubles about every 60 days. Likewise, rate of decrease can be approximated by an exponential with a half time of about 40 days for all radionuclides at both latitudes with the exception of ^7Be at 46°N. ^7Be shows an exponential decrease with a half time of about 60 days. (auth)

25524 (HASL-193) FALLOUT PROGRAM. Quarterly Summary Report, December 1, 1967-March 1, 1968. Hardy, Edward P. Jr.; Rivera, Joseph (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Apr. 1, 1968. 305p. Dep. CFSTI.

Seven papers on the HASL Fallout Program are presented. Separate abstracts were prepared for each. (L.C.L.)

For abstracts of individual sections see: 25525-25530 and 25551.

25525 (HASL-193, pp I.2-16) HAS THE HASL ION-EXCHANGE COLUMN BEEN SERIOUSLY IN ERROR? Volchok, Herbert L. (New York Operations Office (AEC), N. Y. Health and Safety Lab.).

The Health and Safety Laboratory (HASL) maintains a monthly fallout collection network consisting of about 150 stations throughout the world. Of these, some 25% are steep walled stainless steel "pots" and the remainder are plastic ion-exchange column-funnel collectors. There have been indications for several years that some of the ^{90}Sr measurements made by HASL may have been systematically in error. Therefore, an attempt was made to utilize all of the other existing ^{90}Sr fallout data as a means of evaluating the relative efficiencies of the various collection networks and to help clarify this particular HASL problem. The sampling equipment and procedures are described, and data on precipitation and ^{90}Sr concentrations measured at many world-wide stations are tabulated. (L.C.L.)

25526 (HASL-193, pp. I.17-26) ISOLATION OF "HOT" RADIOACTIVE PARTICLES FROM PARTICULATE MATTER COLLECTED AT ARGONNE, ILLINOIS, AND FORT WORTH, TEXAS. Brar, S. S.; Svihla, G.; Nelson, D. M.; Gustafson, P. F. (Argonne National Lab., Ill.).

A method is described for isolating highly radioactive fallout particles from non-radioactive dust on air sampling filters. Six particles ranging in diameter from 2.0 to 10.0 microns were isolated and their fission product content determined. (L.C.L.)

25527 (HASL-193, pp I.33-207) PROJECT AIRSTREAM. Krey, Philip W.; Krajewski, Barbara (New York Operations Office (AEC), N. Y. Health and Safety Lab.).

A study of radioactivity in the lower stratosphere is being conducted using RB-57F aircraft as a sampling platform. Methods of sampling and measuring the radioactivity of the air are described. Flights were flown in Aug. and Nov. 1967 and Jan. 1968 at latitudes from 51°S to 75°N along the western side of the western hemisphere land masses. The results have been plotted to show the variation of ^{90}Sr, total γ, and ^{95}Zr concentrations with altitude and latitude. Data on total gamma radiation, ^{140}Ba, and ^{95}Zr concentrations for various flight conditions are tabulated. The results of the radiochemical analysis of 28 samples taken during Aug. 1967 are tabulated. The ^{22}Rn concentrations in the Jan. 1968 samples are tabulated. (L.C.L.)

25528 (HASL-193, pp I.208-16) 1959 TO 1960 ATMOSPHERIC RADIOACTIVITY PROGRAM. (New York Operations Office (AEC), N. Y. Health and Safety Lab.).

Tables of radioactivity data from a program of atmospheric sampling and radiochemical analysis undertaken during 1959 to 1960 are presented. Aircraft-borne filters were used for sampling. The sampling areas included the troposphere and lower stratosphere over Alaska, troposphere near Hawaii, and lower strato-

sphere over both Argentina and western U. S. The radioisotopes identified were ^{7}Be, ^{137}Cs, ^{144}Ce, ^{89}Sr, ^{90}Sr, ^{181}W, ^{185}W, and ^{95}Zr. (L.C.L.)

25529 (HASL-193, pp I.217-22) ^{90}Sr IN TRI-CITY DIETS: RESULTS FOR 1966 AND 1967 AND COMPARISON WITH PREDICTIONS. Rivera, Joseph (New York Operations Office (AEC), N. Y. Health and Safety Lab.).

In 1964 and 1965, predictions were made of the ^{90}Sr concentrations to be expected in the total diet and diet components in the cities of Chicago, New York, and San Francisco during 1966 and 1967. A summary of measured data on ^{90}Sr in these diets during these years is presented and compared with the predicted values. (L.C.L.)

25530 (HASL-193, pp II.1-30) HASL FALLOUT PROGRAM DATA. (New York Operations Office (AEC), N. Y. Health and Safety Lab.).

Tabulated data are presented on the quantity of monthly atmospheric precipitation at selected US cities from 1957 to 1968 and on the amount of specific radioisotopes due to fallout in the precipitation. (L.C.L.)

25531 (HASL-193(App.)) FALLOUT PROGRAM. Quarterly Summary Report, December 1, 1967-March 1, 1968. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Apr. 1, 1968. 248p. Dep. CFSTI.

Data tabulations are presented on monthly deposition of ^{89}Sr and ^{90}Sr at world land sites and at US cities for the period 1957 to 1968; radiostrontium deposition at Atlantic Ocean weather stations for the period June 1965 to Oct. 1967; the gross gamma and fission product concentrations in surface air at western hemisphere land stations for the period 1963 to 1968; radiostrontium in New York City milk and tap water for the period 1954 to 1968; a table of conversion factors; and a table of radioisotopes of interest in the fallout program with their half lives. (L.C.L.)

25532 (IS-1776) SURVEY OF ENVIRONMENTAL RADIOACTIVITY. Voss, Milo D. (Ames Lab., Iowa). Jan. 1968. Contract W-7405-eng-82. 45p. Dep. CFSTI.

The environmental monitoring program of the Ames Laboratory consists of gross alpha and beta determination of air, soil, vegetation, river water, Ames Laboratory Research Reactor (ALRR) outfall, bottom sediments, precipitation, well water, and pond samples. The data for 1962 to 1968 indicate that the ALRR has not contributed a significant amount of radioactivity to the environment in the Ames Area. The conclusion is reached that radioactivity levels recorded for environmental samples represents background conditions from atmospheric fallout and naturally occurring radioactivity. (auth)

25533 (SZS-4/68) UEBER DIE GROSSRAEUMIGE VERTEILUNG VON SPALTPRODUKTEN IN DER ATMOSPHAERE. (On the Large Scale Distribution of Fission Products in the Atmosphere). Zindler, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East German)). Feb. 1968. 26p. (In German). Dep.

Literature was reviewed on the large-scale movement of the atmosphere using artificial radionuclides released by special nuclear tests as large-scale tracers. The results of ^{89}Sr and ^{90}Sr measurements in precipitation carried out at the Radiation Protection Centre of the G.D.R. since 1959 are also presented. The evaluation of the measurements of the radioactive tracers formed at an altitude up to 400 km showed that four layers of different rapid vertical and horizontal mixing exists in the atmosphere. (auth)

25534 (UCRL-70782) INTERPRETATION OF FRACTIONATION IN FALLOUT FIELDS. Stevenson, P. C. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 29, 1968. Contract W-7405-eng-48. 24p. (CONF-680308-7). Dep. CFSTI.

From 155th National Meeting of the American Chemical Society, San Francisco, Calif.

The fractionation of fission-product species in fallout fields can be understood at least qualitatively in terms of the chemical nature and relative abundances of the short-lived precursors of the observed long-lived species. This consideration leads to the reasonable assumption that the composition of any sample is specified to a defined degree of precision by the concentration of relatively few species. Identification of these species may then give insight into the physical and chemical processes of fallout phenomenology. A computerized algorithm is given for identifying the "best" species for the purpose and determining the minimum number of species necessary. (auth)

25535 (NSJ-tr-98) RADIOACTIVITY IN FALLOUT AND NATURAL RADIOACTIVITY IN AIRBORNE DUST AT THE TIME OF THE SECOND CHINESE NUCLEAR EXPLOSION TEST. Ohshino, Akira; Oki, Iwashiro; Yoshida, Sachiko. Translated from Osaka-Furitsu Koshueisei Kenkyusho Kenkyu Hokoku, 3: 85-8 (Mar. 1966). 11p. Dep. JCL $1.60 fs, $0.80 mf.

This paper was abstracted from the original and appeared in NSA as 21: 41023. (R.C.K.)

25536 TRITIUM GEOPHYSICS FROM 1961-1962 NUCLEAR TESTS. Leventhal, J. S.; Libby, W. F. (Univ. of California, Los Angeles). J. Geophys. Res., 73: 2715-19(Apr. 15, 1968).

Tritium fallout from the 1961-1962 nuclear weapons tests in the Arctic has been measured in southern California and Lake Michigan and at the poles. From these measurements the stratosphere residence time for moisture has been deduced to be about three years. From the oceanic tritium data, the yields of the tests and increase in surface water have been correlated. The 1961-1962 injections have substantially increased our knowledge of the flow of moisture from the northern stratosphere into the southern stratosphere and into the troposphere. These data confirm and re-enforce earlier conclusions about re-evaporation, runoff, and wind transport effects, giving a firmer base for the calculation of the total tritium deposited and the associated past rainfall concentrations. (auth)

25537 GENERATION OF PARTICULATE AEROSOLS FROM PLUTONIUM SURFACES. Chatfield, E. J. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Atmos. Environ., 2: 97-101(Mar. 1968).

Data are presented in graphical form which allow an order of magnitude estimate to be made of the rate of aerosol generation in any size range within 0.1 μm to 10 μm from a plutonium surface oxidizing at any temperature between 20° and 1000°C. Measurements were made in both saturated (16 mg $l.^{-1}$) and dry air (0.01 to 1.5 mg $l.^{-1}$) of the release of airborne material from the pure metal and the delta alloy held in linear airflows between 10 and 80 cm sec^{-1}. (auth)

25538 EFFECT OF FALLOUT ON THE RADIOACTIVITY OF RAIN, SOIL, AND CERTAIN PLANTS CONSIDERED AS A FUNCTION OF THE DATES OF THE EXPERIMENTAL NUCLEAR EXPLOSIONS DETONATED FROM 1961 TO 1965. Boyer, Jean. Bull. Tech. Genie Rural, No. 82, 1-39(Feb. 1967). (In French).

Fallout studies were made from January 1961 to August 1965 at the stations of Antony and Vergière (France). Throughout that period, efforts were made to compare the evolution of levels of radioactivity in rainwater, arable soil, and plant ashes including natural grass sward and some vegetables. Attempts were made to extract from these data some general conclusions concerning the incidences of fallout occurring almost continuously for over four years. (auth)

25539 LONG-LIVED RADIOACTIVITY IN AIR IN THAILAND. Sundara-Vicharana, Yen; Bhodigen, Swang; Hayodom, Vichai. J. Nat. Res. Counc. Thailand, 4: Nos. 1/2/3/4, 1-10(Mar./June/Sept./Dec. 1963). (In Siamese).

In order to check the presence of long-lived radioactivity in air in Thailand, air was drawn through a Hi-Volume Air Sampler at the rate of 49 cfm for four hours a day every day. Each filter paper was separated into two parts, one part for measuring the activity of long-lived radioactivity and the other part for plotting gamma-ray spectrum. Counting of the activity was done after seven days using a G-M counter. A single channel gamma spectrometer with a well type NaI crystal was used in evaluating gamma spectrum. The results indicate that during the period from November 1961 to January 1963, at no time did Thailand receive fallout from nuclear weapons tests exceeding the level of maximum permissible concentration. The long-lived radioactivity in Thailand was found to depend on direction of the incoming air masses. The activity is low when air masses are coming into Thailand from the south or south-west and high when coming from the north or north-east. Since air masses coming into Thailand from the north or north-east usually blow out of Siberia, it was concluded that Siberia is a place where long-lived radioactivity is at a high level. (auth)

25540 ON THE VARIATIONS OF ARTIFICIAL RADIOACTIVITY IN THE SURFACE AIR LAYER. Manolov, Ljudmil; Teneva, Marinka. Izv. Inst. Khidrol. Meteorol., Bulg. Akad. Nauk, 10: 107-25(1967).

It is pointed out that the diurnal and seasonal variations in the values of artificial long-lived radioactivity of the surface air layer are caused by the general circulation of the atmosphere and various local factors. It is found that the dynamics of the atmospheric processes plays an important role in both cases. The effect of precipitations on the content of man-made radioactive substances in the surface air is also discussed. (Abstr. Bulg. Sci. Lit.)

25541 RADIOIODINE FALLOUT OVER THE MIDWEST IN MAY. Machta, Lester (Air Resources Labs., Silver Spring, Md.). Science, 160: 64-6(Apr. 5, 1968).

High concentrations of radioiodine in milk, found preferentially over the midwestern United States after atmospheric nuclear tests in May 1962, 1965, and 1966, can best be explained by high-reaching intense thunderstorms that scavenge passing radioactivity from the upper troposphere and lower stratosphere. (auth)

25542 RADIONUCLIDES AS TRACERS FOR STUDYING LARGE-SCALE EXCHANGE PROCESSES IN THE UPPER ATMOSPHERE. Zindler, Helga (State Radiation Protection Center, Berlin). Beitr. Geophys., 76: 380-92(1967). (In German).

A discussion of the large-scale movements in the atmosphere above the tropopause from results of measurements of artificially radioactive nuclides in the air is given. The data included nuclear weapons tests, simultaneously planned as large-scale tracer experiments, and the results of determinations of strontium-89 and strontium-90. By tracing the radionuclides which were formed at altitudes from 20 to 400 km, three layers with differing vertical and horizontal exchange could be ascertained. In the thermosphere above 100 km the trace materials may be expected to be uniformly distributed in a short time. Within months, as measurements of cadmium-109 show, the trace materials reach the stratopause by turbulent mass exchange in the stratosphere. In the upper stratosphere there is a vertical and horizontal exchange only in the winter months because of the development of disturbances in the region of the polar night jetstream in high and middle latitudes. The lower stratosphere, between 20 km and the tropopause, is on the average characterized by a temperature gradient which remains the same with height or is slightly negative. (ATD)

25543 EIGHTH REPORT TO THE FEDERAL COUNCIL OF THE FEDERAL COMMISSION FOR THE MONITORING OF RADIOACTIVITY FOR 1964. Huber, P. Bull. Eidgenoess. Gesundh., Beil. B, No. 5, 1-88(Sept. 4, 1965). (In German and French).

The radioactive contamination present in Switzerland in the atmosphere, fallout, in water storage reservoirs, surface, ground, and runoff waters, plankton, sediment, water plants, fish, grass, forage, soils, foodstuffs and human tissues is reported. The values of radioactive contamination measured are tabulated and compared as to geographical location, month of the yr, type of γ spectrum found, and sp act. The information is presented in more than 30 tables and charts. (BBB)

25544 NINTH REPORT TO THE FEDERAL COUNCIL OF THE FEDERAL COMMISSION FOR THE MONITORING OF RADIOACTIVITY FOR 1965. Huber, P. Bull. Eidgenoess. Gesundh., Beil. B, No. 6, 177-264(Oct. 1, 1966). (In German and French).

The results of measurements made throughout Switzerland of the radioactive contamination found in the atmosphere, in fallout, in reservoirs, ground waters, surface and runoff waters, plankton, sediment, water plants, fish, grass, forage, soils, foodstuffs, and human tissues are summarized and compared. The spectra of the several types of contamination found are presented. The numerical values of radioactive contamination measured are extensively tabulated and compared with respect to geographical location, month of the yr, and sp act. More than 30 tables and charts are included in this report. (BBB)

25545 THE EFFECTS OF WEATHER ON THE OPTICAL DETECTION OF DEEP SPACE NUCLEAR BURSTS. PART II. Klem, Bernard F.; DeGroot, John S. (E. H. Plesset Associates, Inc., Santa Monica, Calif.). 12p. (CONF-671022-2). DTIE.

From Annual Meeting of the Optical Society of America, Detroit.

The light signature received by a ground based detector from upper atmospheric fluorescent light has been studied for the situation where clouds are present in the field of view of the detector. The fluorescent light is due to the interaction of x-rays, produced by a deep space nuclear burst, with the earth's upper atmosphere. Clouds and overcasts modify the clear air light signal by redirecting and delaying the incident light. In general, the computation of these light signals in the presence of arbitrary cloud distributions is extremely difficult, and it is found that even for the idealized cloud and overcast models studied, the intensity history of the light received by the detector is highly dependent upon the various cloud parameters, i.e., altitude, diffuse transmission, size, position, etc. The major results of the light signature study for simple overcast and cloud models are reviewed. For a zenith burst, it has been found that for a uniform infinite overcast the pulsed fluorescent light signal ($\Delta t \approx 0.1$ μ-sec) originating from a layer at 80 km is spread out over a time interval of about 300 μ-sec. The time of the signal maximum is dependent upon the overcast thickness and altitude. For a disk-shaped cloud a portion of the light signal is similar to that for the infinite overcast. However, discontinuities in the light signature arise from the obscuration effects of the cloud. A combination of disk clouds of equal radii arranged in a regular pattern was found to produce a light signal which fluctuates at a characteristic frequency that is altitude dependent. (auth)

25546 METEOROLOGICAL PROBLEMS IN CONNECTION WITH THE SELECTION OF SITES FOR NUCLEAR POWER PLANTS. Papp, Eva. Idojaras, 71: 358-61(Nov.-Dec. 1967). (In Hungarian).

The meteorologist's tasks in selecting a site for a nuclear power plant comprise meteorological counseling with respect to the site under consideration, performance of special tests and measurements at the site under consideration, and designing, erecting, and operating of a meteorological station that forms part of the nuclear power plant complex. (JPRS)

25547 ON THE DENSITY OF MEASURING GRIDS FOR THE CONTROL OF ATMOSPHERIC RADIOACTIVITY. Zier, M. (Meteorologische Observatorium, Dresden). Kernenergie, 11: 57-9(Feb. 1968). (In German).

The relationship between variations of fission product activity of the near-ground layer of atmosphere of measuring stations differently spaced to each other was studied by means of the simple linear correlation on the basis of long-time measurements. The territorial representativity of the values measured is concluded from the measure of determinancy B as a function of the distance between the measuring stations under consideration, of season, and of the presence of fresh fission products. It is found that the measured values are more representative in summer and in the absence of fresh fission products than in winter and in their presence. Some possible causes for this fact are given. In the radioactivity measuring grid of the Meteorological Service of the G.D.R., about 80% of the activity variations of a measuring station in summer and about 60% in winter can be represented by those of the neighboring stations, the mean distance between them being 130 km and on the condition that fresh fission products are absent. The low representation of measurements at mountain stations is referred to. (auth)

Mineralogy and Exploration

Refer also to abstracts 25244, 25491, and 25502.

25548 THE DISTRIBUTION OF URANIUM IN THE BOTTOM SEDIMENTS OF THE ARAL SEA. Kochenov, A. V.; Baturin, G. N. (Inst. of Oceanology, Leningrad). Okeanologiya, 7: 623-7(1967). (In Russian).

Chemical determination of U in 178 sediment cores was made to determine its distribution over the bottom of the Aral Sea. The U content is distinctly controlled by lithologic facial types and the organic matter content of the sediments. The U maximum is found in the central zones of the bays and lagoons rich in organic matter, reaching above 10^{-3}% in some regions; most of the lake has a concentration between 10^{-4} and 5×10^{-4}%. Other higher deposits include argillaceous silts of the central lake and black argillaceous silt of western coastal indentations; only in the central lake does the C_{org} fail to reach 3.1 to 3.5% as in the rest; there it is only 0.7%. The U balance of the sea was studied. The two rivers flowing into the lake, the Amu-Dar'ya and the Syr-Dar'ya, carry 387 tons/yr of U; the quantity of alluvium is 129×10^6 tons/yr with a U concentration of 2×10^{-4}%, so that the flow is 258 tons U/yr. The total introduction is 645 tons/yr, which also corresponds to the deposited quantity of U. (BBB)

25549 URANIUM FIND IN THE NIGER. Moyal, M. Nucl. Eng., 13: 333-4(Apr. 1968).

The results of 13 years' prospecting in the Niger area are briefly described. In the Arhlit region U washed from the Paleozoic Air range by fossil torrents has been found in restricted pockets and small lenses. The reserve of one area (1.25 sq miles) is estimated at 20,000 te of concentrates with a U content of 70%. Plans for the exploitation of the deposits are described. (UK)

25550 REVIEW OF THE SITUATION OF COMBUSTIBLE MINERALS AND OF PRINCIPAL METALS AND MINERALS IN METROPOLITAN FRANCE AND OVERSEAS TERRITORIES IN 1966. Ann. Mines, 404-49(July-Aug. 1967). (In French).

Data for U are as follows: Production of minerals rose in 1966 to 1139 tons of contained U from 1072 in 1965; chemical concentrates rose to 1647 tons of contained U from 1580. The policy of the Commissariat a l'Energie Atomique remains to produce or buy about 1600 tons at about \$8/lb U_3O_8, and to establish new resources. Future needs were revised upwards in 1966. Research continues in zones covered by the Division of Mines and in other

regions of France, private prospectors were guaranteed purchase until 1971 in Brittany and the Massif Central; research by the government or in collaboration with private concerns was carried out in Gabon, Niger, and the Central African Republic. French production in 1966 was divided between the CEA (688,700 tons mineral; 960 tons U) and private concerns (48,300 tons mineral; 179 tons U); the CEA imported 400 tons of preconcentrated products from Gabon and produced 325 tons of uranothorianite containing 67.3 tons U in Madagascar. It brought 95 tons uranothorianite in Madagascar from private concerns (containing 18.5 tons U). The 1966 (1 July) price for 2 per mil-content U was 40 fr/kg U; 1.5 to 2 per mil-content U was 40 fr (t − 1)/kg U. (BBB)

Oceanography

Refer also to abstract 25548.

25551 (HASL–193, pp I.27-32) OCEAN FALLOUT: THE BAHAMA BANKS EXPERIMENT. Volchok, Herbert L. (New York Operations Office (AEC), N. Y. Health and Safety Lab.).

The question of whether or not debris from atmospheric nuclear tests is deposited uniformly over both land and ocean areas, as presently assumed, is being investigated by measuring the ^{90}Sr fallout on the sea and comparing this data with land station measurements. The shallow waters of the Great Bahama Bank were chosen for the seawater measurements since this water is uniformly shallow and has temporary isolation from the open ocean. The residence time of water on the bank is computed from measurements of the bomb-produced ^{14}C concentrations. The seawater sampling station is described. Both precipitation and seawater samples will be collected and analyzed each month for ^{90}Sr content and compared with the land data. (L.C.L.)

25552 (NYO–3862-7) THE CYCLE OF ORGANIC MATTER IN THE DEEP SEA. Technical Progress Report, June 1, 1967–May 31, 1968. Ryther, John H.; Menzel, David W. (Woods Hole Oceanographic Institution, Mass.). Feb. 1968. Contract AT(30-1)-3862. 10p. Dep. CFSTI.

Oceanographic observations made in the South Atlantic from June 1967 to May 1968 were used to substantiate previous findings that the concentrations of dissolved and non-living particulate organic carbon in seawater are remarkably constant geographically and at all depths from a short distance below the surface to the ocean bottom. The sampling and measurement methods are described briefly as well as their limitations. The age of organic matter was estimated using ^{14}C. (L.C.L.)

25553 URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS. Kuznetsov, Yu. V.; Simonyak, Z. N.; Lisitsyn, A. P.; Frenklikh, M. S. Geokhimiya, No. 3, 323-33 (Mar. 1968). (In Russian).

Data on uranium and thorium concentration in the surface layer of the Indian Ocean bottom sediments are given. Peculiarities of uranium and radium distribution over the ocean floor were investigated. Paragenetic associations of uranium and thorium with components of the chemical and granulometric composition of bottom sediments were studied. Bonds between uranium and organic carbon and phosphorus were established which provides evidence in favor of the existence of a certain mechanism of uranium withdrawal from ocean water. The presence of radium directly precipitated from oceanic water was proved. (auth)

25554 TOTAL β ACTIVITY OF RECENT BOTTOM SEDIMENTS. Senin, Yu. M.; Sherstnev, A. I. Okeanologiya, 7: 628-32(1967). (In Russian).

The total β activity of the bottom sediments from the northwest African shelf made by the Atlantic Research Institute of Fisheries and Oceanography was determined. The β activity was determined in 96 grab samples, and granulometric composition and $CaCO_3$ and organic carbon content determinations were made. The distribution of sediments of different activity over the shelf is presented schematically. Variation in sediment radioactivity was considered in relation to changes of lithological characteristics of the sediments and physical-geographical conditions of sedimentation. The studies described provided background characteristics of the shelf sediments, confirmed the regularity of an increase in activity with a decrease of sediment granularity, showed an insignificant effect of $CaCO_3$ content on β activity in sands, and the absence of such an effect in coarse aleurites and oozes. In sands and coarse aleurites a direct relation was found to exist between the value of β activity and organic carbon content; this relation was not marked in oozes. It was concluded that the mechanism of supply and accumulation of radioactive matter is closely related to the general process of sedimentation, and that variations of sediment radioactivity are due to their granulometric composition and peculiarities of both terrigenous and biogenic sedimentation on the northwest African shelf. (BBB)

25555 THE EFFECT OF TRADE-WIND AIR TRANSPORT ON WATER POLLUTION BY ^{90}Sr AND ^{137}Cs OF THE EQUATORIAL ATLANTIC. Yakovleva, G. V. (Khlopin Inst. of Radiation, Leningrad). Okeanologiya, 7: 617-22(1967). (In Russian).

Data on ^{137}Cs and ^{90}Sr concentrations in the air above the northern Atlantic Ocean obtained in 1964 during the fifteenth cruise of the research vessel "Mikhail Lomonosov" were used to determine what quantity of these radionuclides was carried by the northeast trade wind into the equatorial zone and precipitated there in 1964. The northeasterly air transport of ^{90}Sr and ^{137}Cs does not exert any essential influence on the observed high concentrations of these nuclides in the surface of the equatorial Atlantic. Concentrations observed correspond to 38 and 60 fissions/min; from the data it is calculated that the trade wind transport contributes 0.6 fissions/min (3×10^{-12} Ci/m^3) of ^{90}Sr and 1 fission/min (5×10^{-12} Ci/m^3) of ^{137}Cs. The activity of transported ^{144}Ce is higher, 6 fissions/min (3×10^{-11} Ci/m^3). Air concentrations in this region were found to be ^{144}Ce, 5.0×10^{-14} Ci/m^3; ^{137}Cs, 0.8×10^{-14} Ci/m^3; ^{90}Sr, 0.5×10^{-14} Ci/m^3. Total fallout into the zone in 1964 was ^{144}Ce, 5×10^4 Ci; ^{137}Cs, 8000 Ci; ^{90}Sr, 5000 Ci. (BBB)

25556 ON THE ABYSSAL CIRCULATION OF THE WORLD OCEAN. III. AN ADVECTION-LATERAL MIXING MODEL OF THE DISTRIBUTION OF A TRACER PROPERTY IN AN OCEAN BASIN. Arons, A. B. (Amherst Coll., Mass.); Stommel, Henry Deep-Sea Res., 14: 441-57(Aug. 1967).

A model of abyssal circulation of the world ocean is outlined which is predicated on a dynamic system consisting of highly localized (essentially point) sources of sinking water at high latitudes, transfer of abyssal waters into the interior of ocean basins from a system of western boundary currents, and a geostrophically balanced flow in the interior associated with return of water to the upper layers by a "distributed sink" of very low vertical velocity, the latter being a consequence of the dynamics of the main thermocline. This model was applied, with the superposition of the effects of large scale lateral mixing, to an interpretation of the distribution of radiocarbon and dissolved oxygen in a single ocean basin, focus being made on the distributions of dissolved oxygen and radiocarbon in the abyssal (depths >2000 m) North Atlantic. Radiocarbon data for North Atlantic waters at depths exceeding 2000 m are presented. There is some evidence for a west-east slope, indicative of increasing age to the eastward (similar to that exhibited by oxygen values). The radiocarbon data are treated as representative of a situation in which lateral diffusion effects are dominant and the tracer distribution is smeared out essentially uniformly throughout the basin. The theoretical model predicts a west to east slope of ^{14}C age, consistent with the available observations. The model was used to analyze the interplay between advection and large-scale lateral mixing processes, yielding a value of the order of 6 to 7×10^6 cm^2/sec for the lateral austausch coefficient (A) and 2.0 to 2.5×10^{-3} ml/l yr for the decay rate of dissolved oxygen. The relatively low magnitude of the resulting eddy diffusion coefficient is consistent with the long life times of the Gulf Stream eddies that were observed as persisting over periods of months. The parameters that fit this model to observational facts are of the same order of magnitude as those obtained from box models or still other points of view. (BBB)

Seismology

Refer also to abstracts 25494 and 25558.

25557 (SA–6) ESTIMATED ROCK STRESSES AT MORROW POINT UNDERGROUND POWERPLANT FROM EARTHQUAKES AND UNDERGROUND NUCLEAR BLASTS. Campbell, R. B.; Dodd, J. S. (Bureau of Reclamation, Denver, Colo.). Aug. 1966. 62p. Dep. CFSTI.

Seismic rock stresses, resulting from synthetic and actual earthquakes, underground nuclear explosions, and penstock excavation blasting, were calculated for Morrow Point Underground Powerplant, Colorado. Using elastic vibration theory, underground rock stresses were computed from derived maximum ground particle velocities. These velocities were estimated from empirical expressions for Japanese earthquakes and then compared to California earthquakes. Maximum ground particle velocities for underground nuclear blasts were calculated from empirical expressions derived in the Plowshare Program, and were also estimated from measured ground accelerations during excavation blasting at the site. A correlation was developed relating earthquake intensity and size of underground nuclear blast. Rock

stresses computed from the design earthquake and a comparable underground nuclear explosion were in good agreement. A comparison of these stresses with known rock strengths along with a review of the possible failure mechanisms indicated that the stability of the opening is at least as great for the dynamic condition as for the static condition. Maximum stresses induced by penstock excavation blasting were less than those computed for the design earthquake. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 25534, 25545, and 25830.

25558 (VUF–1035) ANALYSIS OF GROUND MOTION AND CONTAINMENT, STERLING EVENT. Davis, Lawrence L. (Environmental Research Corp., Alexandria, Va.). Jan. 26, 1968. Contract AT(29-2)-1163. 112p. (NVO–1163-107). Dep. CFSTI.

Pre-shot predictions and evaluations of ground motion, stemming and containment are presented and compared with the available observed data. The analysis of seismic data included corrections for frequency response of the instruments, derivation of nonrecorded motions by differentiation and integration, and filtering of the seismic signals to derive amplitude-frequency relationships. Seismic data were available from stations located between 2 to 32 kilometers from surface zero. Observed ground motions were lower than expected from a coupled (fully tamped) explosion of equal size. The peak accelerations and velocities displayed high rates of attenuation compared to Salmon. Relatively small azimuthal variations were observed. Peak motions were associated with frequencies between 3 and 80 Hz. A noticeable decrease in frequency with increasing distance was observed. The purpose of Sterling was to test decoupling theory which predicts that seismic signals can be reduced by detonating a nuclear device in a large cavity. The observed decoupling effects were strongly frequency-dependent. At frequencies between 2 and 5 Hz, particle velocities were reduced by a factor of about 200. Outside this range, observed decoupling factors decreased exponentially with frequency. The observed frequency dependence of the decoupling factor was found to agree with decoupling theory. The prediction of containment and evaluation of the stemming plan were substantiated by the test results. No other post-shot data were available for comparison. (auth)

25559 (VUF–1041) PRESHOT AND POSTSHOT SAFETY SURVEY OF OIL AND GAS FACILITIES, BAXTERVILLE FIELD, MISSISSIPPI: STERLING EVENT. Ward, Don C. (Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center). Jan. 1967. 78p. Dep. CFSTI.

A survey was made to evaluate any physical changes in oil and gas wells resulting from the detonation of the Sterling Event. Structures within a 5-mile radius of ground zero were examined and photographed. Other selected structures within a 6-mile radius were examined and photographed. The preshot and postshot survey indicates that no damage occurred to any oil or gas well or related facilities. (J.C.W.)

25560 (VUF–3025) SUBSURFACE PHENOMENOLOGY MEASUREMENTS NEAR A DECOUPLED NUCLEAR EVENT. Project STERLING. Sisemore, Clyde J.; Rogers, Leo A. (California Univ., Livermore. Lawrence Radiation Lab.); Perret, William R. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1967. 35p.

The Sterling Event, a 380-ton nuclear explosion detonated in a spherical cavity, was a test of decoupling theory for nuclear explosives detonated in explosively generated cavities. Primary objectives included determining the amount of decoupling and evaluating the effects of the altered salt on the decoupling ratio. Measurements of stress history, cavity pressure, and cavity collapse were made in the very close-in region near the cavity wall, and free-field measurements of particle velocity and acceleration were made in the immediate region surrounding the cavity. Accelerations were recorded at locations between 52 and 660 m and particle velocities at locations between 166 and 662 m as measured from the cavity center. Peak accelerations measured over this interval ranged from 150 to 0.2 g and peak velocities from 0.13 to 0.01 m/sec. Analysis of the reduced displacement potentials and their Fourier transforms obtained from Sterling and other tamped events yield a seismic source amplitude ratio of about 100 for a frequency range near 10 Hz. Above 10 Hz the ratio drops rapidly to about 20. These results are in reasonably good agreement with the decoupling theory, and they also verify the preshot theoretical calculations of the decoupling predicted for an explosively generated cavity. (auth)

25561 (VUF–3026) STERLING EXPERIMENT: DECOUPLING OF SEISMIC WAVES BY A SHOT-GENERATED CAVITY. Springer, D.; Denny, M. (California Univ., Livermore. Lawrence Radiation Lab.); Healy, J. (Geological Survey, Menlo Park, Calif.); Mickey, W. (Coast and Geodetic Survey, Rockville, Md.). Oct. 1967. 20p. Dep.

The Sterling experiment was detonated at 380 tons of nuclear yield in the Salmon shot-generated cavity of December 3, 1966, at 0615 CST. Sterling data from several seismic stations that had previously recorded Salmon signals are interpreted to give values of the decoupling of seismic waves. In particular, the decoupling is deduced as a function of frequency for shot-generated cavities operated at the yield level for Sterling (380 tons) and the yield level for Salmon (5.3kt). A value of 70 ± 20 is seen for the two yield levels at 1 to 2 cps, but this reduces in different oscillatory ways to 40 or less above 15 cps. A similar function for 5.3 kt in a mined cavity is derived that shows decoupling values of about 120 at 1 to 3 cps and values less than 10 above 15 cps. The deduced body wave magnitude (m_b) for Sterling is 1.35, which implies that 50 kt fired in a shot-generated cavity would produce a magnitude of about 3.5. (auth)

25562 CONSTRUCTIVE USES OF NUCLEAR EXPLOSIVES. Teller, Edward; Talley, Wilson K.; Higgins, Gary H.; Johnson, Gerald W. New York, McGraw-Hill Book Company, 1968. 332p. $12.75.

The results of research on the constructive uses of nuclear explosives are summarized. Information is included on the effects of nuclear explosions, aspects of energy transfer, radioactivity, Plowshare tests, earth moving and other industrial uses, and scientific applications. (J.R.D.)

Facilities and Equipment

Refer also to abstracts 25519, 25607, 26285, 26341, 26351, 27403, 27437, and 27518.

25563 (AECL–3062) THERMOCOUPLES AND SURFACE TEMPERATURE MEASUREMENT. Otter, A. J. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1968. 21p. Dep. CFSTI. CAN $1.00.

Thermocouples are widely used for surface temperature measurements because of their simplicity, low cost, small size and fast response. Because of the number of variables involved in the transfer of heat between the surface and the thermocouple, the installation designer must generally consider each application as a separate problem. General rules, based on theory and experiment, can be applied in order to reduce the temperature perturbation to a minimum, but limitations imposed by size and materials are often the determining factor in a design. A design manual on the use of thermocouples in temperature measurement is presented. (auth)

25564 (ANL–7392) BLOWBACK OF SINTERED-METAL FILTERS: A REVIEW OF TESTS AND OPERATING EXPERIENCE. Carls, Erwin L.; Levitz, Norman M. (Argonne National Lab., Ill.). Jan. 1968. Contract W-31-109-eng-38. 30p. Dep. CFSTI.

A review has been made of the experience with automatic blowback systems, which have been used in fluidization applications to remove accumulated powders from sintered-metal filters. The blowback systems usually employ 80- to 100-psig blowback motive gas directed periodically into the filter through a $\frac{1}{32}$ to $\frac{1}{16}$-in. nozzle in an opposite direction to the normal process-gas flow for pulse durations of 1 sec or less. Through the use of venturis, part of the blowback motive gas is provided by the exiting filtered gas. A major advantage of pulse blowback is that is reduces the problem of filter plugging that was encountered in continuous reverse-flow blowback systems. With continuous flow, portions of the filter appear to be cleaned too thoroughly; pores that became plugged during subsequent filter use are opened. With pulse blowback, a dust layer remains, which, acting as prefilter, does the filtering in place of the sintered metal. Two parameters have been calculated to reduce blowback design variables to a more fundamental form. For the operating units examined, it has been found that the ratio of the blowback gas rate to the normal forward-flow filtering gas rate has ranged from 1.3 to 10.0, compared with other sources, which indicate that the optimum ratio is 0.5 to 2.0. The second parameter compared has been the ratio of the volume of a blowback pulse to the volume of the internal filter; this ratio had a range of 0.5 to 8.0 for the various units. A comparison of the pressure drop versus flow characteristics of installed filters with literature data for sintered-metal filters indicates that, unless special care is given to the placement of pressure-measuring taps, the observed pressure drop is, more often than not, largely due to the geometry of the off-gas lines and associated fittings. Appendixes are included on: (a) Calculated fines concentration in a fluidized bed as a function of blowback interval and elutriation rate constants. (b) Measurements of the pore size of sintered-

metal filter elements. (c) Measured efficiencies of sintered-metal filters for the retention of particulate fines. (D.L.C.)

25565 (BNWL-481-3, pp 65-6) COMPACT HIGH SPEED SPINNING DISC AEROSOL GENERATOR. Postma, A. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A spinning disc aerosol generator designed to produce concentrated aerosols with mean diameters down to 0.3 μ was fabricated and tested. Aerosol concentrations of 1600 particles per cubic centimeter have been produced; this is more than an order of magnitude greater than can be produced with a generator of earlier design. Particles of mean diameters down to 0.5 μ have been produced and it is anticipated that the goal size of 0.3 μ can be obtained. (auth)

25566 (BNWL-481-3, pp 67-8) DENSITY OF URANINE PARTICLES PRODUCED BY A SPINNING DISC AEROSOL GENERATOR. Sehmel, G. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The densities of 3 to 15 μ dia uranine particles were determined to be from 1.25 to 1.5 g/cm^3 and near the density of the uranine as received. The densities were determined from the mass median diameter and the total mass of particles collected on a membrane filter. (auth)

25567 (BNWL-481-3, pp 94-6) LABORATORY EVALUATION OF ORGANIC FIBER BEDS FOR PARTICLE DE-ENTRAINMENT. Postma, A. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Fiber beds of Teflon and polypropylene were evaluated for potential use in removing submicron aerosol particles from a gas stream. Ninety to ninety-eight percent of 0.3 μ dia dye particles were removed by the Teflon fiber beds when dry but the removal efficiency decreased to about 75% when wet by a spray. A polypropylene fiber bed removed 98% of 0.3 μ dye particles when wet by a fine spray and offered promise in the removal of caustic particles from a saturated gas stream. (auth)

25568 (BNWL-481-3, pp 97-101) PLUTONIUM AEROSOL STUDIES. Andersen, B. V. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The concentration and particle size distribution of ^{239}Pu in breathing air was examined in three Hanford plant facilities concerned primarily in the handling of large amounts of plutonium to determine typical air concentrations and particle sizes that would be encountered in chronic exposure situations at a variety of work locations in plutonium handling facilities. The data collected provide a basis for prediction of employee internal plutonium deposition when utilized with respiratory tract deposition and retention models. (auth)

25569 (BNWL-709) WATER FILTRATION RESEARCH, PART I. THE WATER FILTRATION PILOT PLANT. Schmidt, R. L.; Touhill, C. J.; Olesen, D. E.; Carlile, B. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 23p. Dep. CFSTI.

The water filtration pilot plant, employed in water treatment research programs at Hanford, is described. This pilot plant consists of three unit operations (chemical addition and mixing, flocculation, and filtration) and has extremely flexible capabilities for investigating those parameters which affect water treatment efficiency. Configurations and employment of pilot plant equipment are fully described along with many of the operational procedures. (auth)

25570 (CONF-660706-, pp 159-72) APPLICATION TECHNIQUES IN THE UTILIZATION OF HIGH ENERGY ELECTRON RADIATION. Nygard, John C. (Electra-Process Industries, Inc., Lafayette, Calif.).

The technical and economic factors that must be considered in the use of high-energy electron beams or x rays therefrom in industrial processing applications are discussed. Engineering considerations in the determination of radiation costs and in the most efficient utilization of any radiation source are listed and discussed. These include: the penetration required, the dose required, the dose rate, the geometry of the irradiated product, and the through-put required. It is shown that with proper geometric considerations, high-energy electron irradiators can process materials of modest thickness at a rate in excess of 25000 lb-MRADs/hr. High-energy electrons converted to x rays can process materials of substantial thickness at a rate in excess of 6000 lb-MRADs/hr. (M.C.G.)

25571 (IN-1176) METALLURGY AND HOT CELL BRANCH EQUIPMENT CAPABILITIES MANUAL. Hanny, J. A. (Idaho Nuclear Corp., Idaho Falls). Apr. 1968. Contract AT(10-1)-1230. 27p. Dep. CFSTI.

The Hot Shop and supporting shop facilities at Test Area North (TAN) operated for the U. S. Atomic Energy Commission by Idaho Nuclear Corporation are most versatile for assembly, disassembly, maintenance, and examination of reactors and reactor components. The Hot Shop complex is supported by a fully equipped 50- × 160-ft Hot Cell Facility at the Test Reactor Area (TRA) which is divided into three separate cells for flexibility in performing various types of metallurgical examinations and physical properties tests. The available equipment used specifically for handling radioactive materials in the Hot Shop and supporting Hot Cells at TAN and TRA is described for the following six general types of work: disassembly, repair, and reassembly of radioactive systems; destructive disassembly of radioactive systems and specimen preparation; specimen examinations; physical properties testing; radioactive material special handling and storage; and nondestructive testing. (auth)

25572 (NYO-3740-1) PREPARATION OF THE PORTABLE CESIUM IRRADIATOR FOR OPERATION. Annual Report, June 28, 1966-August 10, 1967. Wootten, C. B. (Isotopes, Inc., Westwood, N. J.). Feb. 7, 1968. Contract AT(30-1)-3740. 56p. Dep. CFSTI.

The preparatory work and arrangements accomplished to make the portable cesium irradiator fully operable prior to its industrial utilization are described. The irradiator design and modifications, project management and user arrangements, licensing trailer modifications, development and use of the thermoluminescent dosimetry systems, operations schedules, and checkout steps are presented. (R.C.K.)

25573 (ORNL-TM-2081) DESIGN STUDIES OF CONDENSERS AND RADIATORS FOR CESIUM AND POTASSIUM VAPOR CYCLE SPACE POWER PLANTS. Fraas, A. P. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 36p. Dep. CFSTI.

The information available on the design and development of condensers and radiators for space power plants has been applied to the preparation of reference designs for condensers and radiators for two 300 kW(e) nuclear electric space power plants employing cesium and potassium, respectively. There is no significant difference in the size or weight of the radiators or the condensers for the two working fluids. (auth)

25574 (RFP-1042) RFD CONTAINER: MODEL 1518 FOR FISSILE CLASS II AND CLASS III SHIPMENTS. Adcock, Frank E.; Wackler, William F. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Apr. 8, 1968. Contract AT(29-1)-1106. 38p. Dep. CFSTI.

The Model 1518 container was developed for shipping radioactive and fissile materials in either solid or powder form. Radioactive materials with up to eight-watts thermal energy may be shipped in each package. Plutonium is limited to 4.5 kg; fully enriched uranium to 11.0 kg. Basic components are a ten-gallon steel drum, Celotex fiberboard insulation, and a steel inner container with a four-inch pipe plug closure. Total cost is about $26. The container easily passed all tests required by the AEC, including a 30-foot free drop and a half-hour fire at 1475°F. Package contents remained under 200°F during the thermal test. (auth)

25575 (SAN-679-7) DESIGN STUDY [OF] ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS: EXPERIMENTAL VERIFICATION. Kouba, C. C.; McCabria, J. L.; Wheat, Norman V. (Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.). Oct. 16, 1967. Contract AT(04-3)-679. 167p. Dep. CFSTI.

A static magnetic mockup was prepared using the available generator components from the previous SNAP-50/SPUR 467-kVA experimental generator development program. The mockup was fitted with search coils to measure magnetic flux levels at a minimum of eighteen different locations within and external to the magnetic circuit. The magnetic unbalance forces and torques created by an eccentric and misaligned rotor and stator were also measured. The measured forces, torques and flux distribution, both useful and leakage, were compared with design predictions. The static mockup of the above experiments was then modified to permit dynamic operation using water cooling and oil-lubricated bearings. The experiments were conducted to measure the no-load losses (pole face, magnetic and field coil) and corresponding temperature distributions at constant speed. The measured data were compared with the analytically calculated predictions. A fluid dynamic test rig from the same generator development program was modified to include a rotor with radial flow pole passages. Experiments were run with "easy-fluids" that simulated potassium to determine flow characteristics of the rotor. (auth)

25576 (SC-RR-67-3026) APPARATUS FOR THE PRODUCTION AND IGNITION OF METAL DROPLETS WITH A

PULSED LASER. Nelson, L. S.; Richardson, N. L. (Sandia Corp., Albuquerque, N. Mex.); Prentice, J. L. (Naval Weapons Center, China Lake, Calif.). Dec. 1967. 19p. Dep. CFSTI.

An apparatus is described which forms and ignites single metal droplets in a controlled atmosphere chamber with a single pulse of focused radiation from a Nd-doped glass laser. Before heating, tiny bits of metal—spheres, granules or squares of foil—are supported in the laser focus either on crossed fibers of the same metal or in an electrostatic levitation device. Photographs of burning droplets at high magnification, complete trajectories, radiant emission histories recorded with a photomultiplier, and time-resolved emission spectra are presented as examples of the information that can be obtained with the apparatus. (auth)

25577 REMOTE-CONTROLLED APPARATUS FOR MEASURING THE INTERNAL FRICTION AND YOUNG'S MODULUS OF RADIOACTIVE MATERIALS. Pokrovskii, Yu. I.; Perevezentsev, V. N.; Vikhrov, V. I. pp 195-203 of Internal Friction in Metals and Alloys. Postnikov, V. S.; Tavadze, F. N.; Gordienko, L. K. (eds.). New York, Consultants Bureau, 1967.

The apparatus described can be used to measure internal friction ranging from values of 5×10^{-2} to 5×10^{-5} in the frequency band of 60 to 600 cps using flexural and torsional vibrations at room temperature, at elevated temperatures to 700°C, and low temperatures to −196°C. It may also be used to measure Young's modulus, shear, and fatigue. (P.G.C.)

25578 WELDING IN THE MANUFACTURE OF CONVENTIONAL AND NUCLEAR POWER WORKS BOILERS. Dolisy, M. E.; Genveray, M. R. Tech. Petrole, 69-78(July 1966). (In French).

Welding processes applied to various components constituting boilers, e.g., chamber tubes, tanks, headers, economizers, and heat exchangers, are described. (auth)

25579 DEVELOPMENT OF A 30-KILOVOLT X-RAY TUBE. Leavitt, George A. Res./Develop., 19: No. 3, 26-31(Mar. 1968). (UCRL-70805).

The development of a new category of x-ray tubes which operate with very high current but short-duration or low current with long-duration is described. (B.G.D.)

25580 EFFECT OF SAND FILTRATION FOR THE REMOVAL OF MANGANESE ON THE RADIOCHEMICAL CHARACTERISTICS OF WATER. Wood, R.; Burden, B. A. (Lab. of the Government Chemist, London). J. Inst. Water Eng., 21: 677-81(Nov. 1967).

The accumulation of radionuclides in waterworks filter bed material is reported. This material (sand, with a coating consisting predominantly of manganese dioxide) arose as a result of a treatment designed to remove Mn from a water supply. The radiochemical examination of the water before and after the Mn removal treatment is described, and the relation of the radiochemical content of the raw and treated water to those radionuclides accumulated on the filter bed material is discussed. The concentrations of the following radionuclides and certain stable elements in raw and treated water and in coated filter bed material are tabulated: ^{40}K, ^{54}Mn, ^{90}Sr, $^{106}Ru/^{106}Rh$, ^{125}Sb, ^{137}Cs, ^{144}Ce, ^{144}Pr, ^{147}Pm, ^{224}Ra, ^{226}Ra, total α activity, total β activity, Mn, Ca, Sr, Ba, and Te. Of the stable elements determined, the treatment process effectively reduced the Mn content of the water below the limit of detection, resulting in the high concentration of Mn, 16% by weight, in the coated filter bed material. On the other hand, the Ca and Sr content of the water rose after lime addition. In the raw sample the total measured β activity of 13.73 pCi/l, calculated with respect to a ^{90}Sr standard, agreed well with the sum of the β activities of the individual radionuclides of 13.27 pCi/l. The corresponding figures for the treated water were 12.66 and 12.49 pCi/l. All the major emitters in the raw and treated water samples were accounted for. The concentrations of ^{144}Ce (with its short-lived daughter, ^{144}Pr, in radiochemical equilibrium) and ^{147}Pm, 2 radionuclides which would be expected to co-precipitate with Mn at pH 9.6, also fell considerably after treatment. These 2 radionuclides were major fallout-derived constituents of the coated filter bed material. The naturally occurring ^{40}K and the ^{137}Cs content of the water dropped less markedly through the treatment process. (BBB)

25581 SAMPLING DEVICE FOR A TAKE-OFF PLANT. Mazoyer, Gaston; Pellerin, Achille (to Commissariat a l'Energie Atomique). British Patent 1,111,114. Apr. 24, 1968. Priority date Mar. 26, 1965, France.

Automatic remote-handling equipment for manipulating the flasks for transferring radioactive liquids into position for sampling is described. (W.H.K.)

25582 VENTILATION DESIGN FOR RADIOCHEMICAL LABORATORIES AT NUCLEAR RESEARCH CENTRE [IN ISRAEL]. Agnon, S. Heat., Piping Air Cond., 39: No. 11, 122-31(Nov. 1967).

The design and operation of the ventilation system of the radiochemical laboratory at the Nuclear Research Center in Israel are described in detail and illustrated with flow diagrams, piping layouts, filter details, and photographs. (L.C.L.)

25583 CONTAINER TRANSPORT CART. Gaedike, H. (Inst. for Physical Chemistry, Berlin). Isotopenpraxis, 4: 74(Feb. 1968). (In German).

A two-wheeled hand-pushed cart for the transport of radioisotopes is described. (M.C.G.)

25584 MOBILE LABORATORY FOR THE ANALYSIS OF NATURAL WATER. Brondi, M. (Comitato Nazionale per l'Energia Nucleare, Rome); Dall'Aglio, M.; Tonani, F.; Visibelli, D. Ind. Mineraria, 17: 7-12(Jan. 1966). (In Italian). (RT/GEO-(66)10).

The portable laboratory and the equipment designed for it for the analysis of natural water are described. The analytical methods used are briefly discussed. (J.S.R.)

25585 SOL-GEL AMINE EXTRACTION (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1692).

35 drawings.

Equipment and flowsheets are described for the pilot plant facility to produce hydrosols by amine solvent extraction to study thorium and depleted uranium products. The throughput is ~1 kg/hr. The equipment used in the process includes contactor, evaporators, organic pumps, racks, tanks, vapor-liquid separators, and water heaters. (For details see TID-4100 Suppl. 45) (F.S.)

25586 SOLEX EQUIPMENT (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1693).

54 drawings.

Equipment and flowsheets used in the Solex solvent extraction facility using the sol-gel amine extraction process for studying ^{233}Pu and ^{233}U products are described. The maximum throughput of the facility is ~4 kg/day. Equipment described includes agitators, contactors, digesters, enclosures, evaporators, heaters, pumps and tanks. (For details see TID-4100 Suppl. 45) (F.S.)

25587 PHASE CIRCUIT DRIVE SYSTEM AMPLIFIER (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1706).

14 drawings.

An amplifier used in the driver system of the Stanford Linear Accelerator phasing circuits is described. The amplifier accepts the 476 Mcps radio waves from the rf generator oscillator. The amplifier brings the signal to a 17.3 kW power level. A coaxial cable distributes the rf power down the 2-mile length of the accelerator. (F.S.)

25588 ULTRASONIC SCANNER (Engineering Materials). (Atomic Power Development Associates, Inc., Detroit, Mich.). (CAPE-1713).

33 drawings.

A scanning system is described which employs a focusing transducer to produce a single narrow ultrasonic beam for locating and discerning objects in high temperature opaque media such as liquid sodium at 600°F. Focusing transducers operate at frequencies of 2.25 and 5 Me/sec with lead zirconate—titanate piezoelectric ceramic disks at distances from $\frac{1}{4}$ in. to 3 ft from the targets. A helix current-sensitive wire recorder displays target images. (For details see TID-4100 Suppl. 45). (F.S.)

25589 GAS COOLER (Engineering Materials). (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). (CAPE-1714).

1 drawing.

A gas cooler is described which is used in the nitric acid recovery system in the Hanford UO_3 Plant. The cooler removes heat from the calciner off gases before the gases are passed to a bubble cap absorber tower in the conversion of uranium nitrate hexahydrate to UO_3. The cooler is 17 ft $1\frac{3}{8}$ in. long, by 32 in. in OD and is fabricated from $\frac{1}{4}$ in. thick type 304 L stainless steel. Eighty-six tubes 1 in. OD with $20\frac{1}{2}$ in. radial fins are welded to a fixed and a floating tube sheet. (For details see TID-4100 Suppl. 45) (F.S.)

25590 CENTRIFUGAL CONTACTOR (Engineering Materials). (Savannah River Operations Office (AEC), Aiken, S. C.). (CAPE-1695).

57 drawings.

Extractors are described which are used in separating plutonium and uranium from radioactive fission products. Holdup time using this equipment was reduced by a factor of 50. Radiolytic degradation of the solvent is also decreased and nuclear safety improved. The extractors are fabricated of stainless steel with a flow capacity over 60 gpm; flow speed is 1750 rpm; and a centrifugal field of ~300 g is developed. Units are remotely operated due to the intense radioactivity of the solutions being handled. (For details see TID-4100. Suppl. 45) (F.S.)

25591 SOL-GEL MICROSPHERE FORMING AND DRYING PROCESS EQUIPMENT (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1691).

55 drawings.

Equipment and flowsheets used in preparing thorium and uranium oxide and thorium-uranium oxide plus carbon sol-gel microspheres and coating them with pyrolytic carbon are described. The equipment includes a 3 in. dia tapered column which maintains a fluid bed condition in drying droplets, 8 in. dia by 7 ft 5 in. high type 304 stainless steel alcohol storage tanks, phase separator, ion exchange columns, recycling heat exchanger, distillation column, dryers, furnaces, piping and control panels. (For details see TID-4100 Suppl. 45) (F.S.)

25592 RECENT ADVANCES IN ENGINEERING SCIENCE. VOLUME 2. Proceedings of the Third Technical Meeting of the Society of Engineering Science held at University of California, November 3-5, 1965. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965. 437p. (CONF-651137-(Vol.2)).

Twenty-three papers are included covering various subjects in nuclear reactors, space propulsion, space physics, plasma physics, materials, and mechanics. Separate abstracts were prepared for eight of the papers dealing with reactor technology and application, celestial mechanics in evaluating space propulsion systems, electric space propulsion, termination of magnetic conjugacy at high latitudes, shock wave structure in plasma, magnetohydrodynamic effects in journal bearings, and failure behavior of fiber-reinforced metal matrices. (D.L.C.)

For abstracts of individual papers see: 25593, 25594, 26046, 26285, 26304, 26402, 27425, and 27427.

25593 CELESTIAL MECHANICAL PROBLEMS IN EVALUATING SPACE PROPULSION SYSTEMS. Stewart, H. J. (California Inst. of Tech., Pasadena). pp 31-51 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

For terrestrial applications of rockets for ballistic missiles or satellite launching systems, the gravitational and aerodynamic losses are small enough so that quite useful comparisons between various propulsion systems can be based on the ideal rocket equation which neglects both gravity and ambient effects. Only the specific impulse and the mass ratio of the system is considered. For example, the losses in a typical satellite launching trajectory represent only about 15% of the total velocity gain required. Going from orbit around the Earth into the more extensive gravitational fields, first of the Earth and then of the Sun, these losses become a relatively more important factor and must be considered in the comparison of different propulsion systems. A particular propulsion system characteristic which has a strong influence is the thrust-weight ratio. The gravitational losses are a function context of the particular mission. However, several typical mission applications are analyzed and the gravitational losses determined. The magnitudes of the effect for the examples considered vary from negligible amounts to as great as a 91% loss in effectiveness in specific impulse. (auth)

25594 ELECTRIC SPACE PROPULSION. Stuhlinger, Ernst (George C. Marshall Space Flight Center, Huntsville, Ala.). pp 53-90 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

The electric space propulsion system has just completed the first phase of its young history. In 1964, six years after laboratory work on electric thrustor components began, several different electric engines achieved successful flight tests in space. These tests proved the feasibility of the system, and opened the gates for further development and eventual application of electric systems to space missions. A review is presented of the basic features of electric propulsion systems, their major components, and their potential missions in space. (auth)

25595 REMOTE-CONTROL MANIPULATOR. Powell, Stanley (to United Kingdom Atomic Energy Authority). British Patent 1,106,472. Mar. 20, 1968. Filed July 31, 1964.

The design of a remote control manipulator is given which is composed of a beam with a master arm pivotably attached and with a slave arm attached on opposite ends. A mechanical linkage between the master arm and slave arm is designed such that a movement of the master arm results in a corresponding movement of the slave arm. (J.C.W.)

25596 IMPROVEMENTS RELATING TO GAS LOCKS. Warner, Dennis Alan (to United Kingdom Atomic Energy Authority). British Patent 1,106,455. Mar. 20, 1968. Filed June 3, 1965.

The design of a gas lock applicable in fluid circuits discharging toxic, radioactive materials is given. The discharging end device allows the material to be removed from the furnace by way of the gas lock platform, into the hood, and out of the hood without shutting down the furnace or contaminating the atmosphere within the chamber and the furnace. (J.C.W.)

Heat Transfer and Fluid Flow

Refer also to abstracts 25563, 25567, 25573, 25613, 27449, 27485, 27501, 27513, and 27525.

25597 (ANL-Trans-586) CONVECTIVE HEAT TRANSFER BETWEEN THE SURFACE AND THE BED OF MOVING PARTICLES. Shlapkova, Ya. P.; Dunskii, V. D. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 55-9 of Issledovanie Teplo-i Massoobmena v Tekhnologicheskikh Protsessakh i Apparatakh, Nauka i Tekhnika, Minsk, 1966. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Heat transfer measurements were made in a model of a moving fluidized bed. The bed material consisted of particles of slag and sand with a mean diameter for the slag particles of 0.78, 1.2, and 2.2 mm, and 0.25 and 0.36 mm for the sand particles. Measurements of the heat transfer coefficients were made with a stationary heat flow from a heater to cooler through stirred bed particles, with and without air flow through the bed. The effects of stirring speed and air flow velocity were measured. The results showed that: although it is possible to reach high heat transfer coefficients in stirred beds, still a considerable increase in this coefficient is observed when the velocity of air filtration through the bed reaches the velocity of the beginning of fluidization; that the convective component can be disregarded for fine particles (smaller than 1.0 mm dia) at atmospheric pressure; and that for large particles (2 to 3 mm dia) the convective component at atmospheric pressure does not exceed 15% of the total heat transfer coefficient. (L.C.L.)

25598 (ANL-Trans-587) SOME PECULIARITIES OF HEAT TRANSFER BETWEEN A THIN FLUIDIZED BED AND A SURFACE IMMERSED IN THE BED. Yuditskii, V. I.; Zabrodskii, S. S. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 19-26 of Issledovanie Teplo-i Massoobmena v Tekhnologicheskikh Protessakh i Apparatakh, Nauka i Tekhnika, Minsk, 1966. 14p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Approximately 150 experiments were carried out to measure the heat transfer coefficients of a horizontal cylinder in the zone of a thin fluidized bed near a grid. Thin layers of sand (0.30 to 1.61 mm dia), of copolymer MSN (0.71 mm dia), and of the CO-conversion catalyst (0.71 mm dia) were fluidized by air at room temperature on a grid with holes of 1.65 mm dia. A cylindrical heating wire of 15.5 mm dia was used as the heat transfer surface. The initial height of the bed was 35 or 70 mm, and the air flow through it was varied from 0.5 to 4.0 m/sec. The effects of each of these variables on the heat transfer coefficient of the wire in the thin fluidized bed are presented quantitatively in graphic form. (L.C.L.)

25599 (ANL-Trans-591) SOME PECULIARITIES OF MOTION AND HEAT TRANSFER OF PARTICLES IN A PULSATING GAS CURRENT. Parnas, A. L. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 33-6 of Issledovanie Teplo-i Massoobmena v Tekhnologicheskikh Protsessakh i Apparatakh, Nauka i Tekhnika, Minsk, 1966. 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A theoretical investigation of the effects of pulsating gas flow on the motion and heat transfer of particles in fluidized beds is presented. (L.C.L.)

25600 (ANL-Trans-592) EXPERIMENTAL STUDY OF THE HEAT TRANSFER BETWEEN A PULSATING BED AND THE HEATING SURFACE. Bokun, I. A.; Zabrodskii, S. B. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 27-32 of Issledovanie Teplo-i Massoobmena v Tekhnologicheskikh Protsessakh i Apparatakh, Nauka i Tekhnika, Minsk, 1966. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

An investigation was undertaken to determine and compare heat transfer coefficients of a pickup after its immersion in a pulsating bed and in a usual fluidized bed of dry sand. A pulsating bed is defined as the state of a dispersed solid material which is penetrated by a pulsating gas current which suffices in order to force the bed into motion. The details of the experimental procedure are described. The bed was composed of dry quartz sand of varying mean diameters from 0.18 to 0.815 mm. The experiments showed that the maximum coefficient of heat transfer between the pulsating bed and the pickup and also between the latter and the fluidized bed is practically equal and is described by the formula $\alpha_{CT \cdot Max} = 35.7\rho_M^{0.2}\lambda_T^{0.6}d^{-0.36}$ with an accuracy of ±15%. (ρ_M = density of granular material, λ_T = coefficient of heat conductivity of the gas, and d = particle diameter.) Such a closeness of $\alpha_{CT \cdot Max}$ can be explained by the great similarity between the heat transfer mechanisms of the pulsating and of the inhomogenous fluidized bed. The best heat transfer is obtained in both cases by the contact of the heating surface with the highly concentrated bed of particles which interchange rapidly near the surface. (L.C.L.)

25601 (ANL-Trans-593) HEAT TRANSFER BETWEEN A PULSATING BED OF MOIST TETRACYCLINE AND THE HEATING SURFACE. Zabrodskii, S. S.; Bokun, I. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 135-9 of Issledovanie Teplo-i Massoobmena v Tekhnologicheskikh Protsesskh i Apparatakh, Nauka i Tekhnika, Minsk, 1966. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Experiments were performed to determine the heat transfer coefficients of a pulsating bed of moist tetracycline with a low-temperature heating surface. Application of a pulsating bed method of drying tetracycline is important because only a low temperature of the drying agent is permitted, and such a method could be mechanized and automated resulting in a more sanitary drying process. A grid was covered with a tetracycline bed approximately 165 mm high. An electric heater with a constant 80°C surface temperature was located in the center of the bed. Air flowed through the bed and grid at pulsation frequencies varying from 0 (steady air current) to 2 Hz. It was found that the heat transfer coefficient increased with increasing air filtration speed and that the optimum pulsation frequency was between 1 and 1.5 Hz. The experiments confirmed that a sharp intensification of the drying of tetracycline occurs at the transition from the steady passage of air to the pulsating flow. The quality of the material dried was satisfactory, and this quality could be further improved by appropriate control of the heating surface. (L.C.L.)

25602 CAVITATION BUBBLE DYNAMICS: SOME EXPERIMENTS AND COMPUTATIONS. West, C.; Howlett, R. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., D, 1: 255-7(Feb. 1968).

Experimental data were collected from individual cavitation bubbles in degassed tetrachloroethylene in an attempt to elucidate the bubble motion. The results are compared with those computed from a modified Noltingk-Neppiras equation. (auth)

25603 SOME EXPERIMENTS ON ULTRASONIC CAVITATION USING A PULSED NEUTRON SOURCE. West, C.; Howlett, R. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., D, 1: 247-54(Feb. 1968).

Experiments on the prompt neutron-induced cavitation effect in tetrachloroethylene are described. Cavitation bubbles were detected by the fast acoustic signals they emit, probably during the collapse phase. Using a pulsed fast-neutron source phase locked to the acoustic field, and a time analyser, information was obtained on the history of bubbles which were nucleated at a known phase of the sound pressure field. Some other properties of the neutron-induced cavitation effect were also investigated using both the pulsed source and a Po/Be source. (auth)

25604 (BNWL-481-3, pp 68-74) PARTICLE DEPOSITION AND RE-ENTRAINMENT IN VERTICAL CONDUITS. Sehmel, G. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The deposition of 1 to 28 μ particles was measured in lengths of 0.21 and 2.81 in. ID aluminum tubes. The particles were either uranine or uranine-methylene blue of a narrow size range generated with a spinning disc aerosol generator. The deposition velocities can be caused to increase significantly by covering the tube surface with a tacky coating. Bases for development of more realistic theoretical models are discussed. (auth)

25605 (BNWL-481-3, pp 75-80) PARTICLE FLUX PROFILES IN TURBULENT TUBE FLOW. Sehmel, G. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The axial flux of particles as a function of distance from the center of a 2.81 in. ID vertical tube was determined under several conditions of average air velocity and particle diameter. Monodisperse uranine particles were employed in these studies. In many circumstances the flux profile of particles was nearly the inverse of the velocity profile. In these cases a region within about 0.2 in. of the wall had a much higher concentration of particles than did the center region of the tube. This "inverse flux profile" was observed under conditions of relatively high net deposition accompanied by significant re-entrainment. Normal flux profiles with a low flux near the wall were observed for small particles and a tacky surface. Since theories to date to explain turbulent deposition have required the assumption of a uniform concentration in the turbulent core of the tube, these models fail to account for observations under conditions giving the inverse profile. Theories to account for deposition must take into account the complex particle distributions in turbulent flow. The problems of withdrawing a representative sample from such a particle transport system were emphasized. (auth)

25606 (BNWL-481-3, pp 81-9) ERRORS ARISING FROM ANISOKINETIC SAMPLING OF PARTICLES FLOWING IN A CONDUIT. Sehmel, G. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Single sized uranine particles from 1 to 29 μ dia were anisokinetically sampled through a 0.402 in. ID probe axially located within a 2.81 in. ID vertical tube. Sampling rates were from 0.3 to 10 times isokinetic flow rates based on average flows which corresponded to velocities from 3.66 to 38.2 ft/sec. The measured concentrations calculated from the sampled air were from 0.3 to 3.2 times the average concentrations in the tube. The measured concentrations are a function of the particle size, sampling rate, and the tube Reynolds numbers. These data establish the inadequacy of known correlations, none of which take into account the effects of the Reynolds number. The measured concentrations are affected by the preferential enhanced concentration of large particles in the region next to the tube wall. The effects of inertia on particle collection in the probe are important for all variables investigated except for particles less than 5 μ for a very limited range of flows. (auth)

25607 (BNWL-481-3, pp 90-3) PARTICLE DEPOSITION WITHIN A CURVED SAMPLING PROBE. Sehmel, G. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Particle deposition was measured in a 4.7 in. length of 0.40 in. ID tubing bent (62 degree elbow) on a 4.4 in. radius of curvature. For both laminar and turbulent flow rates corresponding to average flow, the deposition increased with both flow rate and particle size until re-entrainment became important. For transition flow between laminar and turbulent, the deposition was minimum for an intermediate Reynolds number for any constant particle size for which re-entrainment was not important. The deposition was significant for all flow rates and must be considered in interpreting the data for any sample passed through a curved tube in either laminar or turbulent flow. (auth)

25608 (NP-17416) HEAT TRANSFER DURING FILM CONDENSATION OF POTASSIUM VAPOR ON A HORIZONTAL PLATE. Meyrial, Paul M.; Morin, Michel L.; Rohsenow, Warren M. (Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.). Mar. 1, 1968. Contract GK-1113. 103 p. (DSR-70008-52).

Heat transfer during film condensation of pure saturated potassium vapor on horizontal surfaces of potassium vapor in the presence of small quantities of non-condensable gas is discussed. A discrepancy between theory and experiment concerning the condensation of pure liquid-metal vapors has been explained by thermal resistance at the liquid-vapor interface. This interfacial resistance was analyzed by means of the kinetic theory showing that the results depended on the use of a condensation (or accommodation) coefficient. This coefficient was found to decrease in value at higher pressures. A more refined analysis of the interfacial temperature distribution, including the effect of subcooling in the vapor in the region of the liquid-vapor interface is presented. A theory predicting the temperature drop in the condensate film on a horizontal plate is also presented. Experiments were performed to verify the theory. In addition, data from previous investigators were analyzed. Experiments with non-condensable gases in the saturated vapor were made using the horizontal plate facing upward. These results supported Kroger's theory. (auth)

25609 (ORO-3411-11) STUDY OF THE OPERATING CHARACTERISTICS OF THE HEAT PIPE. Report on Progress During the Eleventh Quarter. Ferrell, J. K.; Schoenborn, E. M. (North Carolina State Univ., Raleigh). Apr. 1, 1968. Contract AT(40-1)-3411. 23p. Dep. CFSTI.

Progress to date on two general experimental programs relating to the operating characteristics of the heat pipe is summarized. The apparatus that has been constructed, the experimental method employed, and the results obtained in the continuing study of heat transfer through porous media are described. Data are presented

on the boiling of water at atmospheric pressure in an immersed bed of monel particles (40 to 50 mesh) supported on a stainless steel electrically heated surface. The equipment, experimental approach, and results obtained on the controlled environment heat pipe are described. Heat fluxes and temperature differences in the evaporator section of the apparatus were determined at atmospheric pressure using water in a capillary bed of the same particles. Angle of inclination of the capillary wick to the horizontal was the parameter of primary interest. A comparison of the results shows surprising similarities at low heat fluxes and small temperature differences. (auth)

25610 (SC-RR-67-2961) AN ANALYSIS OF THE INCREASED AERODYNAMIC HEATING TO THE SNAP-27 GRAPHITE LUNAR MODULE FUEL CASK (GLFC) RESULTING FROM THE TITANIUM MOUNTING STRUCTURE. Spahr, H. R. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1968. 41p. Dep. CFSTI.

A theoretical analysis which defines the increased aerodynamic heating rates resulting from the SNAP-27 Graphite Lunar Module Fuel Cask (GLFC) titanium mounting structure is presented. Local and "average" aerodynamic heating rate distributions in front of a protuberance are presented for six flight conditions. The "average" aerodynamic heating rates immediately in front of a protuberance are approximately ten times the stagnation line aerodynamic heating rate to a GLFC reentering crosswise. (auth)

25611 PROCEEDINGS OF THE FOURTH SYMPOSIUM ON THERMOPHYSICAL PROPERTIES, UNIVERSITY OF MARYLAND, COLLEGE PARK, APRIL 1–4, 1968. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968. 483p. (CONF-680403).

This volume contains 55 papers and 3 lectures covering experimental techniques, critical state, plasma properties, and the thermodynamic, transport, and radiative properties of solids, liquids, gases, and mixtures. Separate abstracts were prepared for nine of the papers dealing with thermal properties of Mo at high temperatures, diffusion of gases in the critical region, thermal conductivity of hot-pressed Be block, transport calculations for nitrogen equilibrium plasma, theory of transport processes in plasma across strong magnetic field, thermodynamic properties of alkali-metal plasmas, potassium seed effects on thermodynamic properties of combustion products of natural fuels, emissivity and electric resistivity of refractory carbides, and thermal conductivity of gases. (D.L.C.)

For abstracts of individual papers see: 25348, 25349, 26047, 26048, 26084, 26275, 26410, 26411, and 26414.

Isotope Technology

Refer also to abstracts 25501, 25508, 25511, 25573, 25575, 25610, 25624, 25703, 26770, and 27470.

25612 (AECL-2782) THE ROLE OF THE NATIONAL LABORATORIES. Runnalls, O. J. C. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Nov. 1967. 21p. (CONF-671047-1). Dep. CFSTI. CAN $1.00.

From Symposium on the Commercialization of Atomic Energy, Quebec City, Canada.

For more than two decades the national nuclear energy laboratories in Canada have played a leading role in the fields of scientific research and development, thus providing the foundation for the production and marketing of radioactive isotopes and the commercialization of nuclear power. A brief account is given of past attainments and the associated evolution of the national laboratories in order to illustrate their relation to the development of a comprehensive Canadian nuclear industry. (auth)

25613 (ALO-3633-8) DEVELOPMENT OF 400 TO 2200°F FIBROUS-TYPE INSULATIONS FOR RADIOISOTOPE POWER SYSTEMS. Quarterly Progress Report No. 5, January 1–March 29, 1968. Collins, J. O.; Jaunarajs, K. L.; Reid, D. R. (Johns-Manville Research and Engineering Center, Manville, N. J.). Apr. 1, 1968. Contract AT(30-1)-3633. 56p. Dep. CFSTI.

ALON-C, a submicron alumina material, was evaluated as a potential base material for a 2200°F MIN-K product. Shrinkage inhibitors and opacifiers in combination with ALON-C were investigated for their effect on shrinkage and thermal conductivity of small, molded discs. Porosity measurements and electron microscope techniques were used to assist in defining the sintering characteristics of these material combinations. MIN-K formulations at various densities were evaluated for load-bearing and thermal conductivity characteristics. Preliminary efforts to formulate an opacified foam silica for load-bearing applications were also initiated. (auth)

25614 (CEA-R-3389) ETUDE DE DIVERS PROCEDES DE MARQUAGES DE SEDIMENTS PAR ^{198}Au. (Study of Various Processes for Marking Sediments with ^{198}Au). Jeanneau, Bernard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1967. 162p. (In French). Dep.

Thesis.

The use of radioactive isotopes for the study of sediment deposits is based mainly on two methods: marking a glass of an element which can be activated to replace the sediment and surface marking—a physico-chemical process is used to deposit a radioelement at the surface of the sediment. The second process is used in particular for sands when it is advantageous to have a large number of particles for statistical analysis. The development of a rapid and simple method of marking which could be applied on the actual site of the experiment where equipment may be limited is described. The method recommended for marking sand with gold-198 is a combination of the Petersen (treatment with tin chloride) and Campbell (treatment with silver) methods combined with prior treatments with nitic acid and caustic soda. Using this method it is possible to deposit 125 mg of Au/kg of sediment with a yield of 95% (i.e., 10 Ci/kg) using a hydrochloric acid solution containing gold. The problem of the solidity of the deposits, of their value, and of their reproductibility is discussed from the point of view of the mineral constitution of the sand. (auth)

25615 (MLM-1466) STABLE ISOTOPE SALES: MOUND LABORATORY CUSTOMERS AND SHIPMENT SUMMARIES, FY 1961–FY 1967. Spicer, D. L.; Hurd, R. W.; Cox, J. G. (comps.) (Mound Lab., Miamisburg, Ohio). Jan. 1968. Contract AT(33-1)-Gen-53. 81p. Dep. CFSTI.

A listing of Mound Laboratory's stable isotope sales for FY-1961 through FY-1967 is given. Purchasers are listed alphabetically and are divided into domestic and foreign groups. A cross-referenced index, by state of purchase, is included for domestic customers and cross-referenced listings, by isotope purchased, are included for FY-1965 through FY-1967. (auth)

25616 (NYO-3109-32) ON THE PREDICTION OF THE PROBABLE DISTRIBUTION OF CONCENTRATION FROM HYPOTHETICAL RADIOACTIVE SOURCES ON THE CONTINENTAL SLOPE OFF THE EAST COAST OF THE U. S. PART I. OCEANOGRAPHIC ANALYSIS FOR DETERMINATION OF THE FIELDS OF MOTION AND DIFFUSIVITY. Reference 68-1. Sastry, J. S.; Okubo, Akira (Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.). Mar. 1968. Contract AT(30-1)-3109. 103p. Dep. CFSTI.

The fate of any radioactive material which might be released into the sea will depend, apart from its radioactive decay, on the physical processes of water movement and dispersion, upon the biochemical processes of exchange and sedimentation, and upon the biological processes of uptake. Given a source of radioactivity at the bottom along the continental slope discharging a specified amount of activity at a given depth between 1000 and 2000 m, the first step in predicting the possible effects on the marine environment is to determine the current patterns which will lead to a transport of the material from the source and to characterize the turbulent diffusion processes by which the material will be dispersed and diluted over an increasing volume. Therefore, an analysis was made of oceanographic data taken between 1937 and 1955 at five locations along the continental slope of the Atlantic Ocean of the United States. The results of this analysis are presented as general background information concerning the horizontal current patterns for the five areas selected. Estimates of vertical velocity and eddy current diffusion are also included. (L.C.L.)

25617 (SAN-651-49) ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM. Quarterly Progress Report No. 7, October 1, 1967–January 1, 1968. Adam, A. Warren (Sundstrand Aviation-Rockford, Ill.). Jan. 15, 1968. Contract AT(04-3)-651. 63p. Dep. CFSTI.

Progress is reported on the development and evaluation of biphenyl and eutectic mixtures of biphenyl and biphenyl ether working fluids for organic Rankine cycle power conversion systems capable of long duration operation in a space environment. The program tasks are the investigation of working fluids, bearings, condensate pumps, and boilers. Four working fluid test loops were run. The operation of one loop was terminated after 2500 hr operation and is being disassembled for inspection. One loop, containing biphenyl, was restarted at 700°F and another has accumulated 3832 hr with a downtime of 3.7%. The final loop has accumulated 2526 hr on its second charge of biphenyl. Both the biphenyl and the eutectic have shown excellent stability in loop tests. Bearing investigations were continued and test components for all configurations except the hybrid were received. The pump test rig and test loop components were received and assembled.

Initial check-out high speed runs were made. Work continued on the boiler test loop. The assembly of the loop is almost complete, the remaining task being the plumbing associated with the boiler pressure transducers. (R.C.K.)

25618 GAMMA IRRADIATION PLANTS AND THEIR APPLICATIONS. Christen, H. Sulzer Tech. Rev., 49: 179-86(1967).

Industrial uses of radioisotopes are discussed, and the design and operation of gamma irradiation facilities manufactured by Sulzer Brother Ltd., Switzerland are described. (L.C.L.)

25619 ENRICHMENT OF URANIUM. Nucl. Eng., 13: 335-40(Apr. 1968).

Methods of enrichment are briefly reviewed. The technical problems in gaseous diffusion plants related to the UF_6 gas, diffusion barriers, and plant control are considered. The plants at Oak Ridge, Paducah, Portsmouth, Capenhurst, and Pierrelatte are described, and size and cost data are given where available. The economics are discussed from the points of view of both the customers and operators of such facilities. (UK)

25620 RADIOACTIVE TRACER METHOD OF INVESTIGATING THE PART PLAYED BY THERMAL MOISTURE CONDUCTION DURING DRYING OF CRUMB-LIKE MATERIALS IN THIN LAYERS ON MOIST SOIL. Volarovich, M. P.; Gamayunov, N. I.; Smirnov, V. I. Colloid J. (USSR) (Engl. Transl.), 28: 656-9 (Nov.-Dec. 1966).

The mechanism of moisture transfer during radiation-convection drying of shredded peat on a moist substrate was studied by a radioactive tracer method. The material investigated was shredded peat of the optimum particle-size composition for the drying conditions, with particles 3 to 5 mm in size. The crumb-like material was previously labeled with $^{35}Na_2SO_4$, kept in desiccators until the moisture content and activity became uniform. Samples for determination of moisture and sp act. were taken 4 times during the drying. A device with a micrometer screw, especially made for the purpose and making relatively accurate and rapid sampling possible, was used for successive removal of dried layers. Equations for handling the radioactivity data were developed; diffusion of the radioactive tracer was not taken into account in their derivation. They are valid when $W_f \geq W_{pc}$, where W_f is free water and W_{pc} is physicochemically bound moisture. The results of calculations based on the equations are illustrated. The part played by thermal moisture conduction during drying of shredded peat crumbs on soil is thereby demonstrated. A method for calculating the flow of moisture into the substrate is given, and the amount of moisture transferred to the deposit during drying as the result of thermal moisture conduction is calculated. (BBB)

25621 USING RADIOACTIVITY IN THE NATURAL GAS INDUSTRY. Fishman, J. B. Instrum. Contr. Syst., 40: 111-13(Nov. 1967).

A review is presented of radioisotope techniques and instrumentation which have application in 3 areas of the gas industry: at the producing fields, during transmission, and laboratory studies. In producing fields the first type of bore hole work using radioactivity was the γ log. Another use is γ-γ logging. A γ-emitting source is lowered into the bore hole; the γ rays, reflected from the surrounding strata, are detected by a detector shielded from the primary radiation. There is a proportional relation between the count rate and the density for high-energy γ radiation. For low energy γ rays, chemical composition dictates the count rate. Other methods such as neutron-neutron logging, neutron-γ logging, and neutron activation logging, to estimate the porosity, gas-water interface, sleeve location, cement location, or chemical composition, are also discussed. Flow characteristics and leakage of gas or water can be traced by injection of ^{14}C-methane or tritiated water. Permeability, leakage, migration, and interwell connections can be determined. In transmission studies, to measure pipe corrosion, a section of pipe is made mildly radioactive. Downstream, a filter captures all the products of corrosion, the count rate of which is directly proportional to the corrosion rate. For use in pipe transmission measurements, derivation and explanation of formulas for flow rate calculations are presented. The 3 major flow rate techniques are described: peak timing, total count, and isotope dilution methods. (BBB)

25622 CHARACTERISTICS OF A TAPERED CASCADE FOR ISOTOPE SEPARATION BY GASEOUS DIFFUSION. Higashi, Kunio; Oya, Akio; Oishi, Jun (Kyoto Univ.). Nucl. Sci. Eng., 32: 159-65(1968).

Usually a number of separating stages have to be connected in series to attain the desired degree of isotope separation by gaseous diffusion. Such a series-connected group of stages is called a cascade. The differential equation describing the time-dependence of a tapered cascade in which the interstage flow changes stage by stage is derived and solved under some reasonable assumptions. On the basis of these analytical results, the static and dynamic characteristics of a tapered cascade are discussed. For the same total number of stages, the cascade requiring the largest equilibrium time to reach steady-state condition is described. Also shown is that the so-called ideal cascade is not recommended from the standpoint of dynamic characteristics, although its superiority in static characteristics is familiar. It is pointed out that by a slight reduction of the cut θ from that of the ideal cascade θ_{ideal} the dynamic characteristics are improved to some extent, but the selection of θ greater than θ_{ideal} results in both static and dynamic characteristics being unfavorable. It is also shown that the equilibrium time of a tapered cascade tends to increase with the total number of stages N in proportion to N^2 as in a square cascade. The top stage is not always the last to reach the steady-state condition. A simple method is proposed to predict how the equilibrium time differs in each stage of the cascade. (auth)

25623 USE OF RADIOACTIVE ELEMENTS IN THE SIDERURGICAL INDUSTRY. Kohn, A. Ann. Mines, 649-62(Oct. 1967). (In French).

A brief review of the properties of radioactive elements is given, and examples of uses as tracers, as radiation sources for control, in laboratory research, in industrial research, in diverse applications, and particularly as sealed sources for the analysis of controls are shown. A discussion of the economics of such equipment as technology evolves in the industry indicate that it is difficult to point out advantages of such equipment over others designed to do the same analysis by a different method, or whether analysis by one method at a particular step in the process should be singled out for recognition in terms of economic contribution. Newer methods in this area, as well as others, will lead to products of higher quality and uniformity at lower cost. (BBB)

Materials Testing

Refer also to abstracts 25571, 25588, 25613, 25617, 26770, and 27491.

25624 (BNWL-649) ULTRASONIC SYSTEM FOR TESTING ISOTOPE HEAT CAPSULES. Dozer, B. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1968. Contract AT(45-1)-1830. 27p. Dep. CFSTI.

A program to develop a nondestructive (ultrasonic) tester and testing procedure to perform integrity tests on isotope heat source containers is described. The increased application of isotope heat sources has brought more attention to the engineering problems encountered during fabrication. One of the most important of these problems is ensuring the isotope containment during the long unattended periods of use. To determine the integrity of the heat source container, a nondestructive testing procedure must be adopted to test each heat source after fabrication. (auth)

25625 (KAPL-M-6913) MASS MATRIX FOR A PRISMATIC BEAM SEGMENT. McCalley, Robert B. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 1968. Contract W-31-109-eng-52. 73p. Dep. CFSTI.

A mass matrix is derived for a prismatic beam by using the deformation function arising in the formulation of the stiffness matrix. This gives a more accurate representation than the simpler method of mass lumping. This presentation differs from the earlier works of Archer and Zurmuehl in that both shear deformation and rotary inertia are included. (auth)

Protective Structures

Refer also to abstract 27450.

25626 (ORNL-TM-2094) FOUR-INCH SHOCK TUBE DRIVEN BY AN EXPLOSIVE GAS MIXTURE. Dresner, L.; Chester, C. V. (Oak Ridge National Lab., Tenn.). Mar. 1968. Contract W-7405-eng-26. 29p. Dep. CFSTI.

A four-inch shock tube driven by an explosive mixture of 79% oxygen and 21% propane with a gage pressure of 20 cm-Hg is described. The shock tube produces peak overpressures up to 400 psi. The energy deposited in air blast is approximately 6 kilocal per foot of length of the original driver section. With these pressures and blast energies it is possible to model exposure of an eight-ft-dia tunnel to a 10-megaton groundburst at the 400-psi circle (or any less severe exposure). (auth)

25627 SCATTERING OF FALLOUT RADIATION FROM CEILINGS OF PROTECTIVE STRUCTURES. Kimel, W. R.; Faw, R. E. (Kansas State Univ., Manhattan). Contract OCD-OS-63-74. Kansas State Univ., Eng. Exp. Sta., Bull., No. 72, 1-168(July 1966).

A study of the ceiling shine problem was made. Ceiling shine is defined to be that contribution to the radiation dose rate in a protective structure resulting from fallout radiation entering the structure through apertures in vertical walls and scattering downward from the ceiling. A systematic analytical analysis of this problem, verified experimentally resulted in a set of design curves. These curves yield the ceiling shine reduction factor in any concrete structure as a function of building dimensions, size and location of apertures, and detector location. (auth)

Radioactive Material Handling

Refer also to abstracts 25571, 25574, 25581, 25583, 25596, and 26037.

25628 (EUR–3664) SITOLOGIE DU STOCKAGE DES DECHETS RADIO-ACTIFS DANS LA COMMUNAUTE EUROPEENNE. (Siting of Radioactive Waste Storage Facilities Within the European Community). Grison, G.; Krause, H.; Leveque, P. Ch.; Pantanetti, F. (Societe Cotrel, Paris (France)). Oct. 31, 1967. 73p. (In French). Dep.

On the basis of the rate of development of electrical energy obtained from nuclear sources it was estimated that by the year 2000 it will be necessary to store a total of 3,000 metric tons of waste fission products, with a residual activity at that date of about 300,000 million curies. A study to pinpoint the regions in the Community capable of accommodating storage facilities for radioactive waste is described. An original method based on the superposition of colored maps is described. Each map represents a parameter. The color range for each map is such that a light color corresponds to areas in which the parameter has a favorable value, while darker colors indicate the less favorable areas. Superposition of the colored parametric maps provides a synthetic map in which the chromatic integration reveals the regions which are theoretically suitable sites for storage facilities. A classification of the criteria is also proposed. Suggestions are made for applying the method to industrial, economic or social problems, in a great variety of combinations. (auth)

25629 (KFK–663) JAHRESBERICHT 1966 DER STUDIENGRUPPE FUER TIEFLAGERUNG RADIOAKTIVER ABFAELLE. (1966 Annual Report of the Study Group for Burial of Radioactive Wastes). Krause, H.; Ramdohr, H.; Schuchardt, M. C. (Kernforschungszentrum, Karlsruhe (West Germany)). Aug. 1967. 22p. (In German). Dep.

Studies made on the burial of radioactive wastes in two salt caverns are briefly discussed. The design of the installation for the introduction of the radioactive material into the salt cavern is described. In the second salt cavern heat generation and corrosion problems are considered. The disposal of radioactive materials in the Atlantic Ocean is briefly discussed. (J.S.R.)

25630 RECEPTACLE FOR THE CONVEYANCE OF RADIOACTIVE SUBSTANCES. (to Commissariat a l'Energie Atomique). British Patent 1,105,845. Mar. 13, 1968. Priority date Mar. 31, 1966, France.

The design of a receptacle is given with a shielded enclosure having a protective plug. Inside the chamber containing the radioactive material is a spring with one end connected to the vessel and the other to a gripping plate abutting the plug when it is in position. When the plug is disengaged, the plate emerges from the enclosure. (J.C.W.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 25911 and 26929.

General Detectors and Monitors

Refer also to abstracts 25939 and 26578.

25631 (AWRE-O-9/68) ANALYSIS OF RECOIL PROTON SPECTRA. Benjamin, P. W.; Kemshall, C. D.; Brickstock, A. (Atomic Weapons Research Establishment, Aldermaston (England)). Mar. 1968. 49p. Dep. CFSTI. UK 7s. 0d.

A FORTRAN computer code SPEC 4 for measuring neutron spectra in a low-power fast reactor by analysis of the energy distribution of recoil protons in a hydrogen-filled proportional detector is presented. Both internal and external errors are calculated. (W.H.K.)

25632 (ORNL-TM-2137) DESCRIPTION OF GAMMA-NEUTRON RADIATION MONITORING SYSTEM INSTALLED IN THE 5-Mv VAN DE GRAAFF ACCELERATOR AREA OF THE HIGH VOLTAGE ACCELERATOR FACILITY, BLDG. 5500. Holladay, J. H.; Knowles, D. J. (Oak Ridge National Lab., Tenn.). Feb. 22, 1968. Contract W-7405-eng-26. 13p. Dep. CFSTI.

A radiation monitoring system was installed in the 5-Mv Van de Graaff Accelerator Facility in Building 5500 to continuously monitor gamma-neutron radiation in each of five areas. The radiation level in each area is indicated by a meter on a panel board in the control room and by another meter at the entrance to the area. Alarm indicators are actuated at the control panel and in the monitored areas when a caution level (30 mrem/hr) or a high level (100 mrem/hr) of radiation is detected or when an instrument becomes inoperative. Beacons are operated in the monitored area when a caution or high level of radiation is detected. This report describes the system and gives general maintenance information. (auth)

25633 (UCID-15318) GAMMA SENSITIVITY vs ENERGY OF VARIOUS DETECTORS. Still, Duncan; Robinson, Judy (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 1, 1964. Contract W-7405-eng-48. 9p. Dep. CFSTI.

The gamma sensitivity of several detectors was measured as a function of gamma energy. The detectors were calibrated at 0.5, 0.74, 1.25, and 2.76 MeV. The types of detectors investigated were the L-24 fluor(PD head), Cherenkov, L-22 Compton diode (with thin end windows), and solid-state (PIN type). (B.G.D.)

25634 AMPLITUDE OF PULSES IN HOMOGENEOUS CRYSTAL COUNTERS (METHOD FOR DETERMINING THE RANGE OF CHARGED PARTICLES). Vitovskii, N. A.; Ryvkin, S. M. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semiconduct. (Engl. Transl.), 1: 31-3(July 1967).

Because of the successful application of semiconductor counters in nuclear physics, there is new interest in the possibility of using homogeneous semiconductor systems for recording ionizing radiations. Calculations are presented for the through pulse current amplitude Δi obtained when a counter is irradiated through one of its electrodes. The current amplitude was considered as a function of the applied voltage V_0, the crystal thickness L, the range of the ionizing particle a, and the equilibrium density n_0 of the majority carriers in the counter material. It was shown that the amplitude of the through pulse current depends strongly on the polarity of the applied voltage and on the thickness (L−a) of the unionized layer. Measurements of the signal amplitude in counters of different but exactly known thicknesses can, in principle, be used as a method for the very accurate determination of the range of ionizing particles. The value of Δi was determined by solving a system of equations for the densities of electron and hole currents, the continuity equations, and Poisson's equation for a known distribution of the electric field E along a crystal. (BBB)

25635 AUTOMATIC X-RAY EXPOSURE TIMERS IN PEDIATRICS. Schuster, W.; Gajewski, H. (Univ., Erlangen-Nuernberg, Ger.). Z. Kinderheilk., 101: 223-9(Nov. 6, 1967). (In German).

The usual triple field ionization chamber is not suitable for use in taking x-ray exposures in infants, because the measurement field is either too large or the instrument cannot be properly adjusted to the widely differing body size of children. If the size of the localization device is reduced from 55 × 90 mm down to 40 × 60 mm, and the sensitivity of the exposure timer is increased the field to be photographed can be defined more exactly, and thus the irradiation exposure can be reduced. A measurement chamber that increases the effective exposure by from 10 to 15%, as compared to the usual ionization chamber is described in general terms. (BBB)

25636 COMPARATIVE EVALUATION OF A WHOLE-BODY COUNTER ^{40}K METHOD FOR MEASURING LEAN BODY MASS. Roessler, Genevieve S.; Dunavant, Billy G. (Univ. of Florida, Gainesville). Amer. J. Clin. Nutr., 20: 1171-8(Nov. 1967).

Techniques, instrumentation, and results of using a whole-body counter to determine lean body mass (LBM) from ^{40}K measurements are presented. The whole-body counter method of determination of LBM is based on the assumption that the K content of LBM is nearly constant and that fat is essentially K free. The accuracy and reproducibility of the whole-body counter method for measuring LBM was evaluated by comparing the results in 77 subjects with the results using an anthropometric method, a creatinine method, and with reported literature values. It was shown that when the whole-body counter ^{40}K method is compared statistically with the anthropometric method, there is no difference between the results obtained. A poor correlation exists between the whole-body counter method and the creatinine method on the basis of a single measurement by each method. It was concluded that the whole-body counter ^{40}K method is a valuable means of determining LBM, not only because of its convenience and rapidity, but because of its accuracy and reproducibility. (BBB)

25637 DIGITAL AUTOFLUOROSCOPE. Fitzer, L. F. (Baird Atomic Ltd., Hornchurch, Eng.). Bio-Med. Eng., 2: 488-9(Nov. 1967).

A new type of scintillation camera is described and illustrated. It is called the Digital Autofluoroscope, and incorporates a detector which comprises a mosaic of 294 small Tl-activated NaI crystals instead of a large single crystal as used in the Anger type camera. A multiple-channel collimator of up to 3 in. in thickness, giving a mosaic configuration, permits the use of digital techniques to locate scintillation. The detector crystals are optically coupled to 35 photomultiplier tubes so arranged to correspond with the X and Y axes of the magnetic core memory with 294 storage positions. Each phototube is connected to a pulse amplifier; the output of the amplifier is fed to a lower level discriminator set just above the system noise level and the discriminator outputs are fed directly to the memory address register. The outputs of the X and Y amplifiers also go to a summing amplifier, the output of which is then fed to a pulse height analyzer, with its output going to a memory timing generator. An automatic cross talk eliminator rejects a count if signals are detected simultaneously in more than one crystal, thus eliminating recording of intercrystal Compton scatter. After the accumulation period the data are displayed on the face of the cathode-ray tube for visual observation. (BBB)

25638 MEASUREMENT OF NEUTRON FLUX BY USE OF THE FLUCTUATION OF CURRENT FURNISHED BY DETECTORS (PRINCIPLE OF MEASUREMENT AND ELECTRONICS). Plaige, Y.; Quenee, R. Automatisme, 12: 325-30(Sept. 1967). (In French).

Measurement of neutron flux in a reactor is made by placing an ionization chamber at some convenient place. The chamber produces a current proportional to the flux in which it is placed. The ionization chamber is followed by an electrometric amplifier delivering, at low impedance, a voltage which can be either a linear or a logarithmic function of the current. The current has an intensity which fluctuates about a certain mean value. One may examine either the mean value or the fluctuations about it. The amplifier described presents a logarithmic characteristic and amplifies the current fluctuations produced by the ionization chamber. The power dynamic is about 10^6. The detector must be protected against external noise, particularly 50 Hz. It would be difficult to adapt this amplifier to a periodometer with a response time less than 5 sec; but because of the discrimination which the detector permits, measurement time is improved in cases where there is an important γ level, such as in the Pégase reactor. (BBB)

25639 WALK-OVER ALPHA HAND AND SHOE MONITOR USING AIR PROPORTIONAL DETECTORS. Splichal, W. F. (E. I. Du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Health Phys., 14: 520-1(May 1968). (DP-MS-67-78).

A walk-over alpha monitor was developed to survey hands and shoes of personnel when they exit a controlled area. More people

can be checked in less time by this monitor than by conventional stand-on hand and shoe monitors or other survey instruments. Approximately 3000 dis/min of alpha-emitting material on the hands or shoes of a person crossing the monitor at a normal pace will actuate an alarm. (auth)

25640 KRYPTON DIFFUSION IN SCINTILLATION COUNTER PLASTIC. Norton, F. J. (State Univ. of New York, Albany). Nature (London), 218: 165(Apr. 13, 1968).

It is stated that a possible source of error in the determination of radioactive krypton in the atmosphere, employing plastic scintillators, is diffusion of the gaseous krypton into the solid plastic, and its retention. In order to evaluate this, measurements were made of the permeation rate (P), diffusion constant (D), and solubility of krypton in the polymer normally employed (polyvinyltoluene). Permeation rates for the most abundant isotope, ^{84}Kr, were determined by mass spectrometry; the values thus obtained were very close to those for ^{85}Kr, since the quantum isotope effect in permeation is very small. The lag time to steady state enabled determination of the diffusion constant. The solubility was given by 7.6 P/D. Results are tabulated for temperatures of 25°, 50°, and 75°C. The activation energy for permeation was found to be 10,000 cal., and for diffusion 13,000 cal. The time to half saturate a degassed sheet, with Kr on both sides, was found to be 5 hr., and it is concluded that if the plastic is exposed to ^{85}Kr for several hours during scintillation measurements the dissolved gas remaining in the plastic can be an important factor. At an equilibrium pressure of 1 atm. the volume of gas held in the plastic at 25°C is almost the volume of the plastic. For precise measurements this gas must be desorbed and pumped away before introduction of the next sample. (UK)

25641 LIQUID SCINTILLATION COUNTING OF TRITIUM IN WATER WITH TRITON EMULSION SYSTEMS. Williams, P. H. (International Atomic Energy Agency, Vienna). Int. J. Appl. Radiat. Isotop., 19: 377-83(Apr. 1968).

An optimum mixture is specified for the toluene–Triton–water emulsion system shown by previous investigators to be superior to other systems, both heterogeneous and homogeneous, for the counting of low-level tritium in water. The optimum mixture contains 30 percent water, a 25 ml sample being counted in a commercial Packard spectrometer with a background of 10 counts/min and 15.5 percent efficiency, corresponding to 120 T.U./counts/min. Counting times for low activities and specified precisions are less than one-third those necessary with the best homogeneous dioxane-based system. In combination with a simple enrichment technique the Triton system makes possible the rapid assay of tritium concentrations as low as 25 T.U. with 6 percent precision. (auth)

25642 INVESTIGATIONS ON TERNARY FISSION AND SCATTERING OF FRAGMENTS OF URANIUM BY MEANS OF SOLID STATE TRACK DETECTORS. Somogyi, Gyoergy (Kiserleti Fizikai Intezet, Debrecen, Hungary). ATOMKI (At. Kut. Intez.) Kozlem., 9: 297-306(Dec. 1967). (In Hungarian).

The scattering of fission fragments on nuclei ^{39}K and ^{16}O in track detectors of mica and hostaphan were studied. The occurrence of ternary fissions of natural uranium bombarded by 14-MeV neutrons was investigated using both mica and hostaphan. The relative frequency of ternary and binary fissions was found to be $2{,}6.10^{-4}$ when using hostaphan and $1{,}9.10^{-3}$ when using mica. This result, taking the different sensitivity of these detectors into account, means that the ternary fission with a light third particle (mass number is about 15–30) is more frequent than that with a heavy third particle (mass number is >30). (auth)

25643 INVESTIGATION ON ALPHA–GAMMA PULSE SHAPE DISCRIMINATION AND ALPHA ENERGY RESOLUTION OF CsI(Tl) AS A FUNCTION OF TEMPERATURE BETWEEN 200° AND 360° K. Novak, Nezsoe. ATOMKI (At. Kut. Intez.) Kozlem., 9: 307-17(Dec. 1967). (In Hungarian).

Alpha-gamma separation in pulse shape discrimination of a CsI(Tl) crystal, produced by Gamma Optical Works, was studied between 200°and 360°K by a PSD instrument working on the cross-over principle. The energy of the bombarding alpha particles was 8.78 MeV, while that of the gamma rays 0.66 MeV. It was found, that the PSD separation worsens by cooling and improves by heating the crystal. From 300 to 360°K the distance between the alpha and gamma peaks has grown by 20%. However practical use cannot be made of the improvement in PSD separation, except special cases, because of the simultaneous reduction of light amplitude, which is partly caused by the scintillation mechanism and partly by the necessarily bad optical coupling between crystal and photomultiplier. Also, investigations on the temperature dependence of alpha energy resolution of CsI(Tl) are reported. The measurements were performed in the temperature interval of 200 to 360°K and relating to the 8.78 MeV alpha line of Th(B + C). It was found that the energy resolution reached its minimum value at about 310°K, and it worsened both by heating and cooling. From the resolution vs reciprocal amplitude diagram of the results it becomes evident that in the case of the same amplitudes the resolution is worse at low temperatures than at high ones. It seems probable therefore that the process of larger statistical fluctuation belongs to the shorter component of the scintillation of CsI(Tl). (auth)

25644 AN IMPROVED FLOW COUNTER FOR DETECTING β-EMITTING RADIOISOTOPES. Martin, James K. (Ames Research Center, Moffett Field, Calif.). Anal. Biochem., 22: 238-41(Feb. 1968).

A simple flow-type detector for β-emitting radioisotopes is described which gives a linear response over a wide range of activity (2000- > 500,000 cpm) and a rapid washout of radioactivity (approximately 3 cell volumes). ^{32}P was counted with an efficiency >50% and ^{131}I was counted with an efficiency of 14%. The flow cell will detect ^{32}P and ^{131}I activity in whole blood and it can also be used with nonaqueous solutions and solutions of high color or extreme pH. (auth)

25645 COMPARISON OF TECHNIQUES FOR WHOLE-BODY COUNTING OF γ-RAY EMITTING NUCLIDES WITH NaI(Tl) DETECTORS. I. POINT SOURCES IN PHANTOMS. Dudley, R. A.; Haim, A. Ben (International Atomic Energy Agency, Vienna). Phys. Med. Biol., 13: 181-93(Apr. 1968). (IAEA-2819-8).

A two-part study is presented on the efficiency and accuracy with which γ-ray emitting radionuclides in man can be assayed by various whole-body counting procedures. The comparison includes measurement geometries of three types (scan, arc, and chair); NaI(Tl) detectors of four sizes; radionuclides that are variously distributed in the body, and emit γ-rays covering a wide range of energy; spectral analysis based on counts in either the photopeak or the full pulse-height spectrum; and investigations on both phantoms and man. The experimental and theoretical methods are described and applied to point sources of radionuclides in phantoms in order to isolate and to clarify underlying processes which collectively affect measurements on dispersed sources in man. Numerical results are given for a wide range of measurement conditions. (auth) (UK)

25646 COMPARISON OF TECHNIQUES FOR WHOLE-BODY COUNTING OF GAMMA-RAY EMITTING NUCLIDES WITH NaI(Tl) DETECTORS. II. DISTRIBUTED SOURCES IN PHANTOMS AND HUMANS. Dudley, R. A.; Haim, A. Ben (International Atomic Energy Agency, Vienna). Phys. Med. Biol., 13: 194-204(Apr. 1968). (IAEA-2819-9).

The methods described in Part I are used in measurements and calculations on radionuclides dispersed in a phantom and in man. It is shown that assays accurate within a few per cent can be obtained in most circumstances unless limited by counting statistics, and that the efficiencies of assay can be generalized, in suitably normalized form, to a wide range of instruments, techniques, and radionuclides. (auth) (UK)

25647 ELECTRON SCATTERING FROM SILICON SEMICONDUCTOR DETECTORS. Planskoy, B. (Birkbeck Coll., London). Nucl. Instrum. Methods, 61: 285-95(May 15, 1968).

A quantitative investigation of electron scatter from Si semiconductor detectors over the energy range 50-625 keV has been made. All detectors used had depletion depths greater than the electron range in Si. The scatter coefficient, p, was determined in the usual way from the areas under the line and the so-called low energy tail which constitute the observed spectrum when mono-energetic electrons fall on a detector. Experimental results are given for the dependence of p on primary electron energy, E_0, on the angle subtended by the detector at the source and on the size and material of any collimating aperture. Measurements of the energy distributions of the scattered electrons are also given. The measured value of p for E_0 = 625 keV and a detector of area 100 mm^2 is shown to vary from 0.15 ± 0.02 for perpendicular electron incidence to 0.42 ± 0.02 for 35% collection efficiency. No differences in scattering properties were observed between lithium-ion-drift and surface-barrier detectors, and the spread in measurements between detectors was within that due to the experimental method. All experimental results given here, as well as the apparent inconsistencies of those in recent publications are satisfactorily explained on the basis that the value of p measured in this way is not identical with the saturation backscatter coefficient, p_b, for Si, as had been assumed hitherto. Instead, p is shown to be a total scatter coefficient, p_t, incorporating 3 groups of electrons: those backscattered from the Si; those which have lost some energy before reaching the detector by being scattered from other parts of the apparatus; and, if no aperture is used, those which are scattered out of the sides of the sensitive volume of the detector. It is shown how the relative

contribution of the 3 groups to p_t varies with E_β and the geometry of the experiment and how a knowledge of these factors and of p_b can be used to calculate p_t for any geometry to agree to within ±0.03 with the measured value. (auth)

25648 FEATURES OF ALPHA SCINTILLATION COUNTERS FOR RADIOMETRIC AND DOSIMETRIC INSTRUMENTS. Gorbunova, L. V.; Tyminskii, V. G. Izv. Vyssh. Ucheb. Zaved. Geol. Razved., No. 9, 119-22(1966). (In Russian).

Results of laboratory tests of various alpha counters for radiometric and dosimetric apparatus are presented and discussed. Graphs show the dependence of α counting rate on the brand of luminous compound used; the dependence of the consumption coefficient of α radiation of the different luminous compounds on α particle energy; the dependence of the consumption coefficient of α particles of different energy on distance between source and K-9 brand scintillator and on the method of applying the luminous compound. (Geophys. Abstr.)

25649 GADOLINIUM NEUTRON DETECTOR. Feigl, B.; Rauch, H. (Atominstitut der Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods, 61: 349-56(May 15, 1968). (In German).

Systematic measurements of the attainable efficiency and the background sensitivity of a new thermal neutron detector are reported. The neutron detection is due to the measurement of conversion electrons produced by the prompt neutron capture γ-rays in Gd (natural Gd and ^{157}Gd). For the detection of conversion electrons surface barrier detectors are used. A detection efficiency exceeding 40% can be obtained. A further advantage is the extremely small size of these detectors and their low sensitivity for background radiation (fast neutrons and γ-rays). (auth)

25650 LINEAR POLARIZATION MEASUREMENTS. Lee, F. D.; Watson, D. D. (Wright-Patterson Air Force Base, Ohio). Nucl. Instrum. Methods, 61: 328-32(May 15, 1968).

The use of the Compton polarimeter is discussed for the measurement of linear polarizations of gamma rays from aligned nuclear excited states. A set of formulas is given for calculating the polarization-correlation of any member of a multiple gamma-ray cascade and for calculating the Compton scattering asymmetry expected from a polarization measurement. Corrections for the finite geometry of the polarimeter are discussed and simple approximate formulas are given for calculating the geometrical correction coefficients. The results of exact numerical computer calculations for one sample geometry are compared with the results of the approximate formulas. The mechanical construction and electronic circuitry for a typical Compton polarimeter and the shape of the pulse height spectrum obtained by summing the pulses from the scattering and absorbing detectors are discussed. (auth)

25651 MEASUREMENT OF LOW ENERGY X-RAYS. I. GENERAL CONSIDERATIONS. Greening, J. R.; Randle, K. J. (Univ. of Edinburgh, Scotland). Phys. Med. Biol., 13: 159-68(Apr. 1968).

Consideration is given to the measurement of the energy fluence of a low energy (50 kV maximum) x-ray beam. A research program is outlined in which a total absorption calorimeter, chemical dosimetry, and gaseous and solid state ionization dosemeters are used to measure this energy fluence. Theoretical formulas are derived to calculate the fluorescent and scattering energy losses from these measuring devices. (auth) (UK)

25652 PARTICLE FLUX RECORDED BY A MINIATURE DETECTOR INSIDE A BETA-EMITTING MEDIUM. Bryant, T. H. E.; Smart, Gloria A.; Pryce, W. I. J. (Middlesex Hospital, London). Phys. Med. Biol., 13: 239-45(Apr. 1968).

The β-particle flux recorded by a miniature Geiger-Müller detector immersed in a homogeneous medium containing a uniform distribution of a β-emitter was measured. The results indicated the expected change in β-flux with variation of annular thickness of medium containing the β-emitter. Theoretical equations are developed which may be used to calculate the flux for any type of cylindrical detector immersed in a medium containing a β-emitter. (auth) (UK)

25653 POLARIZATION MEASUREMENTS OF NUCLEAR GAMMA RAYS. Taras, P. (Univ. of Montreal). Nucl. Instrum. Methods, 61: 321-7(May 15, 1968).

A computer program has been used to do a systematic study of the asymmetry ratio R, of a Compton polarimeter. The effects of the finite sizes of the crystals that make up such a polarimeter are discussed. Conditions that should optimize the sensitivity of a polarization measurement are also presented. (auth)

25654 RADIOLUMINESCENCE OF ORGANIC MEDIA. I. KINETIC STUDY. Voltz, R.; Laustriat, G. (Centre de Recherches Nucleaires, Strasbourg-Cronenbourg, France). J. Phys. (Paris), 29: 159-66(Feb.-Mar. 1968). (In French).

A description is given of the formation, the evolution and the spatial arrangement of activated molecules in organic scintillators excited by high energy particles. The kinetics of the prompt and the delayed scintillation components are described. The prompt emission is shown to result from molecular excitation in upper singlet states, followed by internal conversion to the lowest singlet level responsible for fluorescence emission. The delayed component is attributed to emission from singlet states formed during the encounter of two triplet excitons in the particle track. Equations are obtained defining the time dependence of intensity and the integrated intensities of both components, in the case of pure or binary systems containing or not quenching substances like molecular oxygen.

25655 SIGNAL-TO-NOISE RATIO OF TIME-DEPENDENT FILTER FOR IMPROVING ENERGY RESOLUTION IN NUCLEAR SPECTROSCOPY WITH SEMICONDUCTOR DETECTORS. Weise, K. (Physikalisch-Technische, Brunswick). Nucl. Instrum. Methods, 61: 241-4(May 15, 1968). (In German).

The signal-to-noise ratio of a time dependent filter proposed by Schuster for improving the energy resolution in nuclear spectroscopy with semiconductor detectors is calculated and found to be only 3.7% below the value of the optimum filter and better than the signal-to-noise ratios of other filters, especially 31% greater than that of the RC-integration-RC-differentiation-filter commonly used. (auth)

25656 THE ASYMMETRY RATIO OF A COMPTON POLARIMETER: A COMPUTER PROGRAM. Taras, P.; Matas, J. (Univ. of Montreal). Nucl. Instrum. Methods, 61: 317-20(May 15, 1968).

A computer program has been written to calculate the asymmetry ratio of a Compton polarimeter which consists of two cylindrical NaI(Tl) counters whose axes are parallel to each other. The calculations are in good agreement with the experimental values deduced from the polarization measurements on the gamma rays of ^{65}Ni and ^{85}Sr. (auth)

25657 THE USE OF TAPPED DELAY LINES FOR OPTIMAL FILTERING OF NUCLEAR PULSES. De Wit, P.; Wolff, A. C. (Rijksuniversiteit, Utrecht). Nucl. Instrum. Methods, 61: 237-40(May 15, 1968).

A realization of a matched filter by means of a tapped delay line is described. The measured signal-to-noise ratio is close to the theoretical optimum. (auth)

25658 VALIDITY OF THE MODULATION TRANSFER FUNCTION OF RADIOGRAPHIC SCREEN-FILM SYSTEMS MEASURED BY THE SLIT METHOD. Rossmann, K.; Sanderson, G. (Eastman Kodak Co., Rochester, N. Y.). Phys. Med. Biol., 13: 259-68(Apr. 1968).

The line spread-function (LSF) and modulation transfer function (MTF) of radiographic screen-film systems containing double-coated film are often determined from slit exposures. The measurement procedure involves conversion of the density distribution in the slit image to the corresponding effective illuminance distribution in the film sandwich by means of large-area sensitometry of the film as a whole. The validity of this procedure has been questioned in the literature. For several screen-film systems of different optical and sensitometric properties as examples, it is shown experimentally that the method yields LSF's which permit prediction of outputs from known inputs to the systems. These results and consideration of some theoretical aspects of the transfer theory of linear systems indicate that present LSF's and MTF's form a self-consistent, valid description of the transfer characteristics of present screen-film systems. It is possible, however, that other equally valid descriptions will be found, depending on the manner in which outputs are measured. (auth) (UK)

25659 CONTROL APPARATUS FOR DETECTING β AND γ RADIATIONS. Roulet, R. (to Commissariat a l'Energie Atomique). Canadian Patent 777,859. Feb. 6, 1968. Priority date Jan. 16, 1963, France.

Several Geiger–Mueller detectors are located in the uprights of gantry between which persons walk who may be contaminated. The amplifier and other electronic equipment is contained in a box on the top. There are two integrator circuits with time constants differing by more than five seconds. The circuit includes a preamplifier and electronic flip-flop shaping circuit, a galvanometer as indicator, a relay controlled by the galvanometer which actuates an audible warning signal. Another circuit connected to the galvanometer increases the sensitivity at low radiation. (F.S.A.)

25660 IMPROVEMENTS IN AND RELATING TO PULSE COUNTING APPARATUS AND TO THE MEASUREMENT OF RADIATION FROM RADIOACTIVE MATERIALS USING PULSE COUNTING APPARATUS. Finch, Harold William Stuart (to Isotope Developments Ltd.). British Patent 1,111,121. Apr. 24, 1968. Filed Apr. 7, 1964.

A circuit for analyzing the pulses from a radiation detector is presented. The system provides for automatic subtraction of background radiation. (W.H.K.)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 26932.

25661 MOESSBAUER EFFECT STUDIES. PART I. THE MOESSBAUER SPECTROMETER. Whitefield, H. J. (Victoria Univ., Wellington, N. Z.); Vickerman, J. R. N. Z. J. Sci., 9: 782-90(Dec. 1966).

A Moessbauer spectrometer is described in which modulation of the γ-ray energy is achieved by use of an electromechanical transducer based on a permanent magnet from a commercially available loudspeaker. A multichannel analyzer used in time mode stores the spectrum and the motion of the transducer is synchronized with the channel advance of the analyzer by a crystal oscillator with an electronic gating circuit. The transducer for driving the source consists of 2 permanent Rola 12U loudspeaker ring magnets, mounted back to back with a hollow aluminum cylinder passing through their common axis. The lower voice coil is driven by a sinusoidally varying voltage at a frequency corresponding to the mechanical resonance frequency of the suspension system. A voltage signal appears at the upper voice coil proportional to the velocity of the source. The channel advance pulses for the analyzer are frequency-stabilized by an illustrated circuit. Another circuit which is described synchronizes source motion with channel advance pulses. By maintaining the temperature of the lab containing the apparatus to within ±1°C, the long term drift of the spectrometer was reduced to less than one channel in 400 over one week. The positions of the Moessbauer peaks of Fe compounds can be determined with a reproducibility of ±0.02 mm/sec. The spectrometer can resolve the potassium ferricyanide doublet which has a splitting of 0.28 mm/sec at 22°C. (BBB)

25662 RESOLUTION AND INTENSITY IN NEUTRON SPECTROMETRY DETERMINED BY MONTE CARLO SIMULATION. Dietrich, O. W. (Atomic Energy Commission Research Establishment, Risoe, Denmark). Nucl. Instrum. Methods, 61: 296-300(May 15, 1968).

The Monte Carlo simulation technique was applied to the propagation of Bragg-reflected neutrons in mosaic single crystals. The method proved to be very useful for the determination of resolution and intensity in neutron spectrometers. (auth)

25663 SIMPLE METHOD FOR SIMULTANEOUS MEASUREMENT OF TWO INDEPENDENT AMPLITUDE SPECTRA USING ONE MULTICHANNEL ANALYSER. Schlenk, Balint; Valek, Aladar. ATOMKI (At. Kut. Intez.) Kozlem., 9: 393-6(Dec. 1967). (In Hungarian).

The basic description of a circuit for measuring simultaneously with a single multichannel analyzer two independent amplitude spectra obtained from different detectors is given. (auth)

25664 MAGNETIC β-SPECTROMETER "KETRON" FOR INVESTIGATION OF ISOMERS FORMED IN NUCLEAR REACTIONS. Rakivnenko, Yu. N.; Klyucharev, A. P.; Romanii, I. A.; Skakun, E. A.; Yatsenko, G. I. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 13: 478-82(Mar. 1968). (In Russian).

A method is described for the investigation of the millisecond isomers by means of a magnetic β-spectrometer in combination with the proton pulsed accelerator. The isomeric levels are excited in nuclear reactions induced by protons in the target mounted in the spectrometer focus position. Magnetic analysis of internal conversion electron spectra is carried out in the intervals between the accelerator bursts. The results of studying the conversion electron spectra of delayed transitions in ^{90}Nb, ^{146}Eu, and ^{180}W are presented. (auth)

25665 SECONDARY ELECTRON SPECTROSCOPY. Harris, Lawrence A. Ind. Res., 10: 52-6(Feb. 1968).

Use of Auger electrons for analysis of materials by secondary electron spectroscopy is reviewed. How the radiationless emission of electrons from atoms bombarded by low energy is characteristic of the atoms from which they originate is explained. A device is shown schematically which is a secondary electron spectrometer recently developed to measure the energy of Auger electrons. Low-energy electrons emitted from the electron gun impinge on a sample held in the circular sample holder. Secondary electrons, including groups of Auger electrons, are emitted from the surface of the sample. These electrons enter the curved electrostatic-deflection energy analyzer through a small slit in the face plate. The analyzer acts as a sorter, keeping electrons with too much energy or too little energy from entering the electron multiplier. The output of the analyzer is differentiated electronically to enhance the characteristic Auger signatures. Another new technique is also described, the electron spectroscopic chemical analysis (ESCA) method. In this technique, sample material is irradiated with x rays and the distributions of both Auger and photoemitted electrons are observed. However, ESCA requires a flux of primary x rays and, therefore, high-power apparatus. The spectra are more complex than those of the Auger component alone. This method has been used for light as well as heavy elements and is capable of determining electron valence states as well as electron binding energies in light elements. The use of fairly energetic x-ray excitation, however, makes electron spectroscopic chemical analysis less sensitive to surface conditions than secondary electron spectroscopy. (BBB)

25666 HIGH ENERGY RESPONSE FUNCTIONS OF A GERMANIUM GAMMA RAY SPECTROMETER. Allen, B. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Sci. Appl., 3: 74-9(Oct. 1967).

Response functions for high energy gamma rays of a large coaxial germanium diode have been obtained and analyzed in terms of photon absorption mechanisms. Line shapes and peak efficiencies are given to 17.6 MeV. Double escape peak efficiencies are related to spectra obtained when the detector is operated as a pair spectrometer. (auth)

25667 MEASUREMENT OF ABSOLUTE THICK-TARGET BREMSSTRAHLUNG SPECTRA. O'Dell, A. A. Jr.; Sandifer, C. W.; Knowlen, R. B.; George, W. D. (EG and G Inc., Goleta, Calif.). Nucl. Instrum. Methods, 61: 340-6(May 15, 1968).

Absolute energy spectra were measured for thick-target bremsstrahlung produced by incident electrons in the energy range of from 5.3 to 20.9 MeV. To obtain these spectra, a 0.2 radiation-length gold-tungsten target was bombarded by electrons from the EG&G/AEC linac, and the bremsstrahlung emitted in the forward (zero-degree) direction was measured by use of a technique based on deuteron photodisintegration. Apparatus and experimental techniques are described, and absolute spectra are given for electron energies of 5.3, 6.8, 8.0, 10.0, 12.0, 14.0, 16.4, and 18.0 and 20.9 MeV. (auth)

25668 1.6 GeV/c SPECTROMETER (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1705). 88 drawings.

A spectrometer designed to be used with primary electrons and γ radiation for maximum energy of 1.6 GeV/c to study large backward angle scattering processes at the Stanford Linear Accelerator is described. The instrument consists of one dipole magnet bending a total of 90°, 2 quadrupole elements and a sextupole triplet with quadrupole and sextupole strengths chosen to provide the first- and second-order properties demanded. Input and output pole faces of the magnet are rotated to provide transverse focusing. The spectrometer can be positioned to an indicated 0.001°. (For details see TID-4100 Suppl. 45). (F.S.)

High Energy Physics Instrumentation

25669 (BMwF-FBK-68-02) EINE BLASENKAMMER MIT GEPULSTEM MAGNETFELD. (A Bubble Chamber with Pulsed Magnetic Field). Bauer, P.; Bergmann, W.; Boehmisch, A.; Gruber, J.; Hahn, G.; Ksoll, M.; Moustafa, K.; Reinke, J.; Watschoeder, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Jan. 1968. 85p. (In German). Dep.

The construction of a propane bubble chamber with a pulsed magnetic field is reported. The magnet is a single turn coil with an inside diameter of 7 cm and a height of 10 cm and serves as chamber body. In order to keep eddy currents low the expansion system has been made mainly of plastics. The current is generated by a crowbarred capacitor discharge, the rise time of which is 15 μsec. The capacitor bank-maximum storage energy 300 kJ - is also described. The operation of the chamber and the results of a chamber test run at C.E.N. Saclay are presented. The maximum field obtained in this test was 235 kG. (tr-auth)

25670 (BNL-12362) TRANSMISSION-LINE TYPE LARGE DIGITAL SPARK CHAMBERS. Fischer, Joachim; Shibata, Shinkichi (Brookhaven National Lab., Upton, N. Y.). [1968]. 12p. (CONF-680207-6). Dep. CFSTI.

From 11th Scintillation and Semiconductor Counter Symposium, Washington, D. C.

A transmission-line type digital spark chamber is described

consisting of electrodes of etched wires on an "H" Film substrate, backed by a bonded metal foil. The foils are pulsed from one end and are terminated and connected to the wires at the other end. The chamber gives uniform response. The size of the spark was investigated for several HV pulse shapes and amplitudes. The efficiency is high even to multiple sparks because the spark impedance in gases with quenching vapors is high relative to the line impedance, and because of the strong coupling to the pulsed foils. (auth)

25671 (UCRL-17938) LOW-COST LARGE-SCALE MAGNETOSTRICTIVE SPARK CHAMBER DIGITIZING SYSTEM. Kirsten, Frederick A.; Rudden, Robert J. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 21, 1968. Contract W-7405-eng-48. 11p. (CONF-680207-7). Dep. CFSTI.

From 11th Scintillation and Semiconductor Counter Symposium, Washington, D. C.

A compact low-cost large-scale digitizing system for spark chambers has been developed. This system uses a single clocked scaler and a high-speed integrated-circuit memory. The number of words of memory required is equal to the sum of the number of sparks expected in all the chamber gaps plus the number of start fiducial pulses expected (one per transducer channel). Each magnetostrictive transducer is assigned certain addresses in the memory. As pulses arrive from the sensors, the current contents of the scaler are stored in the appropriate preassigned addresses of the memory. To avoid synchronization problems, a Graycode scaler is used. The memory is made of 16-bit integrated-circuit scratch pad memory elements. The system could be operated with the clock frequencies of up to 40 MHz. The storage capacity of the system is expandable. This system is compared with other known systems. (auth)

25672 (NP-tr-1651) SEMICONDUCTORISED CONTROL CIRCUIT FOR A SPARK-CHAMBER FILM-SCANNING INSTRUMENT. Cech, J. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by C. R. Brightmore for Atomic Energy Research Establishment, Harwell, Eng., from report JINR-P10-3122. 8p. Dep. CFSTI. UK. JCL $1.10 fs, $0.80 mf.

A transistorized control circuit for a semi-automatic instrument for scanning spark chamber films is presented. (W.H.K.)

25673 OPTIMIZATION OF DIMENSIONS OF COUNTERS AND DISPERSERS IN EXPERIMENT ON DETERMINATION OF POLARIZATION OF SMALL ROENTGEN RAYS. Zharko, A. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 6, 94-7(Nov.-Dec. 1967). (In Russian).

An analysis of various methods for determining the polarization of weak x-ray beams showed that Thomson's scattering method is the most efficient. A certain concept of efficiency of counters and scatterers is introduced in order to determine the optimum dimensions of the instruments using the Thomson method. The calculations of the optimum were also possible at a certain given energy of quanta, because of the magnitudes of μ (linear damping coefficient) and μ_g absorption coefficient of assigned energy x-ray quanta in the gas (of gas filled counters). The case of 10-keV quantum energies with a beryllium scatterer and counters filled with 0.9 atm xenon and 0.1 atm methane was resolved. (R.V.J.)

Radiation Dosimeters

Refer also to abstracts 26752 and 27442.

25674 X-RAY AND GAMMA-RAY DOSIMETRY BY COMBINING CdS PHOTORESISTANCE CELLS WITH ORGANIC SCINTILLATORS. Fietz, J.; Stolz, W. (Institut fuer Anwendung Radioaktiver Isotope, Dresden). Kernenergie, 11: 53-6(Feb. 1968). (In German).

A midget scintillation probe consisting of a commercial-grade CdS photoresistance cell and an organic plastic scintillator is described, serving for the measurement of x-ray and gamma-ray exposure rates within the range from 1 to above 10^3R/h. A low inertia of reading is obtained by constant background excitation of the CdS photoresistor using a ^{147}Pm-activated ZnO phosphor. The strong dependence on quantum energy of the reading of pure CdS dosemeters is essentially lowered by employing organic scintillators. The probe may be utilized in radiotherapy because of its small dimensions and favorable properties. (auth)

25675 USE OF LiF (TLD 700) FOR DOSES GREATER THAN 0.1 M rad. Jones, J. L.; Martin, J. A. (Moleculon Research Corp., Cambridge, Mass.). Health Phys., 14: 521-2(May 1968).

It is stated that while the normal technique employed, depending on the release of essentially all the light in the main glow peak centered around 200°C, is effective up to about 1 MR, beyond this dose the light output of the peak commences to decrease. In this higher dose region, however, another peak appears on the glow curve, at a higher temperature, and increases up to about 2 MR. The light from the higher peak can be read simply by increasing the heater current. The ratio of peak heights is a strongly varying function of dose and can provide an accurate indication of dose up to 10 MR. (UK)

25676 BIBLIOGRAPHY OF THERMOLUMINESCENT DOSIMETRY. Lin, F. M.; Cameron, J. R. (Univ. of Wisconsin, Madison). Health Phys., 14: 495-514(May 1968).

This bibliography contains 505 references. (UK)

25677 EFFECT OF ULTRAVIOLET EXPOSURE ON THERMOLUMINESCENT CaF_2:Mn. Puite, K. J. (EURATOM-ITAL, Wageningen, Netherlands). Int. J. Appl. Radiat. Isotop., 19: 397-402(Apr. 1968).

After an ultraviolet exposure of read-out thermoluminescent CaF_2:Mn powder, a second reading can be obtained. Some experiments were carried out to find a relationship between the previous and the uv induced response. Ultraviolet exposure offers possibilities for repeated readings, and there is a difference between the response to gamma rays and to heavy particles. (auth)

25678 THERMOLUMINESCENT MICRODOSIMETRY SYSTEM FOR THE MEASUREMENT OF PHOTON QUALITY. Greenhouse, N. A. Jr.; Maillie, H. D.; Mermagen, H. (Univ. of Rochester, N. Y.). Radiat. Res., 32: 641-50(1967).

Thermoluminescent lithium fluoride and calcium fluoride were studied to determine the feasibility of their use in measuring x- or γ-ray spectral quality. Both of these materials were quantitatively packaged as microdosimeters, and exposure-versus-thermoluminescence response calibration curves were determined for several x- and γ-ray effective energies. The ratio of calcium fluoride to lithium fluoride response was taken as the index of radiation quality, and a calibration curve for this ratio versus effective energy was also determined. The technique was found to be useful for effective photon energies between 50 and 300 keV. The calibrated dosimeters were exposed at various depths in a large water phantom. Curves were plotted of dose and effective energy as functions of depth in the phantom for several incident x-ray energies. These curves were compared, where possible, with published data. (auth)

25679 SOLID-STATE DIGITAL INTEGRATING X-RAY DOSIMETER. Kemp, L. A. W.; Bottrill, D. O.; Klevenhagen, S. (London Hospital, Eng.). Phys. Med. Biol., 13: 231-8(Apr. 1968).

A dosemeter is described in which the voltage excursions of the integrating capacitor are controlled by the trigger and reset voltages of a transistorized Schmitt circuit. Before triggering the Schmitt circuit presents a very high input impedance to the integrating capacitor, whereas after triggering its input impedance falls by comparison to a very low value, enabling the integrating capacitor to discharge to the Schmitt reset voltage level within a few msec; adequate compensation is incorporated for likely changes in temperature and mains supply voltage. (auth) (UK)

25680 TWIN IONIZATION CURRENT AMPLIFIERS AND RATIO-METER USING SOLID-STATE MODULAR DEVICES. Walton, P. W. (Western Regional Hospital Board, Glasgow). Phys. Med. Biol., 13: 281-4(Apr. 1968).

The instrument described was designed as part of a system for measuring radiation dose distributions with the x-ray field from an 8 MeV linear accelerator specifically in mind. The system automatically scans the x-ray fields in a water phantom, at different depths perpendicular to the beam axis, and thus produces tables of transverse data which form the basis for computer calculation of single and multiple beam isodose curves. The instrument has two small ionization chambers (0.4 cc), one for scanning the field and the other to function as a stationary reference. Errors due to beam fluctuations are eliminated by taking the ratio of the two ionization currents. Modern solid-state modules (operational amplifiers and a multiplier/divider unit) are used throughout, resulting in a compact and easily operated instrument. The output from the ratio-meter is digitized and printed at each of a preselected matrix of points in the field. Many other uses are envisaged for this instrument, which was designed to measure currents from 10^{-11} to 4×10^{-10} amp. (auth)

25681 USE OF THE FARMER-BALDWIN AND VICTROMETER IONIZATION CHAMBERS FOR DOSIMETRY OF HIGH ENERGY X-RADIATION. Greene, G.; Massey, J. B. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Phys. Med. Biol., 13: 287-8(Apr. 1968).

The authors answer the comments by Almond (Phys. Med. Biol. 13: 285-6(April 1968)) on their earlier communications (Phys. Med. Biol. 11: 509(1966) and 12: 257(1967)). (UK)

25682 STUDIES ON CHEMICAL DOSIMETER. I. LEUCO TRIARYLMETHANE COMPOUNDS. Hakariya, Satomi (Nagasaki Univ., Japan); Takei, Chikara. Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1093-1100(Nov. 1967). (In Japanese).

4,4'(5-chloro-2-thenylidene) bis[N,N-dimethylaniline], a derivative of leuco triarylmethane compounds was investigated as an aqueous chemical dosimeter for ionizing radiations. The synthesis of the compound is described in detail and basic matters related to dosimetry by this compound are reported. An aqueous solution composed of 10^{-4} M leuco compounds, 10^{-4} M $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$, 10^{-4} M NaCl, and 7×10^{-3} M HCl was used as the dosimeter. Color change of the solution after irradiation was measured by a photoelectric spectrophotometer of Beckman type. The optical density at the main absorption peak of 635 mμ increased linearly with increasing x and γ doses up to approximately 2000 R; above this, the curve was not linear. The minimal measurable dose was 100 R. No dose-rate dependency existed between 5.6 and 126.5 R/min of ^{60}Co γ rays (2000 Ci). The fluctuations of the measurement data obtained by using the same sample was negligible, while those from different samples were within 10%. Optical density was independent of temperature below 27°C, but above this it was temperature dependent. Direct exposure of the sample to the light should be avoided. Extraction of the dye using an organic solvent extends the lower range of the dosimeter to 25 R. Spontaneous discoloration was observed in irradiated or nonirradiated aqueous solutions or in the estracted layer, if left at room temperature (18 to 23°C). However, nonirradiated sample showed no spontaneous discoloration within 3 mo if kept in a cool and dark place. The measurement of its optical density should be done within 10 hr following irradiation. Spontaneous discoloration of the extraction layer was negligible within 1 hr following extraction and, if the extraction layer was washed with pH 2.2 HCl solution, its discoloration could be retarded. (NSA of Japan)

Radiometric Instruments

Refer also to abstracts 25507, 25510, and 25513.

25683 QUANTITATIVE EVALUATION OF INTERFERING EFFECTS IN THE RADIOMETRIC MEASUREMENT OF K_2O. Vielhauer, Siegfried. Kali Steinsalz, 4: 402-14(Dec. 1967). (In German).

Radiometric procedures are described for quantization of K_2O (as ^{40}K) in various salts and bases, and in certain industries engaged in manufacture of cloth and in mining operations. The electronic equipment used and the specific environmental conditions necessary to optimize accuracy and speed of analysis are described. Sources of theoretical and actual measurement errors are compared. Temperature changes within the measurement console cause an error of 0.09% K_2O/deg. Temperature changes in the linear amplifier of the measurement probe cause errors ranging from −0.03 to 0.01%/deg, depending on the applied potential. Due to variations in the amplification factor of the multiplier, the count level is not constant over long measurement periods, so that in 10% salt solutions an error of 0.13% may result. In 55 to 60% salt solutions, the error is ~0.5%. Deviations in the apparent density in the range between 800 to 1000 g/l give errors of 3.2 to 3.4% K_2O/100 g/l, but are only 0.6% K_2O/100 g/l in the range of 1100 to 1400 g/l. At average values of up to 3% the Kieserite concentration in samples may have a marked error effect. Sample quality has a greater effect on error than has measurement equipment. Combined sources of error may produce an over-all error of from +0.3 to +1% K_2O error. With proper care the error can be held to the lower value, using 5 min counts. The value of an "infinite" layer is ~100 to 120 cm. (BBB)

25684 USE OF CORONA COUNTERS IN DETERMINATION OF THE MOISTURE CONTENTS OF DISPERSE MATERIALS BY THE NEUTRON BACKSCATTERING METHOD. Volarovich, M. P.; Skvortsova, N. I. Colloid J. (USSR) (Engl. Transl.), 28: 660-3(Nov.-Dec. 1966).

It is necessary for the determination of absolute H_2O content to use a highly efficient moisture detector, reliable and stable in operation. For development of such an instrument, efficiencies of various slow-neutron detectors by the method developed for previous investigations were used. The choice of a highly efficient detector of slow neutrons makes it possible to lower the activity of the source, and thus to facilitate protection and also to raise the sensitivity of the method. Technical efficiency offers a convenient method for comparing slow-neutron detectors. A detector probe based on the SNM-11 counter was constructed for rapid determination of the moisture contents of disperse materials by the neutron backscattering method. The efficiency of the SNM-11 counter was compared with that of other slow-neutron counters in studies of H_2O content of sand and peat. Determinations showed that the SNM-11 counter is superior to counters of other types for use in neutron moisture meters for disperse systems by factors of 5 or greater. (BBB)

25685 MEASURING DEVICE FOR THE CONTROL OF BORIC ACID CONCENTRATION IN REACTOR FACILITIES. Faehrmann, K.; Jaepel, F. (Zentralinstitut fuer Kernforschung, Dresden). Kernenergie, 10: 337-40(Nov. 1967). (In German).

The mechanical construction, detection electronics, and operational principle of a measuring device for the monitoring of the boric acid concentration in reactor facilities is described. The measuring device permits the determination of the concentration in the range $0 \leqq c \leqq 10$ g B/l with an accuracy of ≦5% and works up to the operation temperature of 120°C, operational pressures of 120 atm, and a γ background of 120 R/hr. (tr-auth)

25686 INVESTIGATIONS OF THE NEUTRON SLOWING-DOWN METHOD FOR MEASUREMENT OF THE WATER CONTENT OF VARIOUS MEDIA. Oelgaard, P. L. (Danish Atomic Energy Commission, Riso). Trans. Ing., No. 9(1967). (In Danish).

The physical principle of neutron moisture gauges is described. Comparative theoretical and experimental investigations at the Research Establishment Risoe with subsurface probes are discussed, and some of the results obtained are presented. Good agreement was found between measured calibration curves and theoretical calibration curves as obtained by the use of three-group diffusion theory. (auth) (DENM)

25687 COMBINED HYGROMETER-DENSITOMETER USING RADIOISOTOPES. Nagy, A.; Razga, T. Meres Automat., 14: 113-4(1966). (In Hungarian).

The system developed by the authors is used for the simultaneous determination of the moisture content and density of the material (soil, etc.) subject to measurement. The probe for sinking into the medium contains a ZnS-boron polyester neutron detector, a plastic scintillator for detecting gamma-rays, a common photoelectron multiplier and a discriminator stage for separating the signals originating in both scintillators according to their shape. The probe is connected to the counter through a 10 m long cable. According to calibrating measurements, max. 10 min. are needed for attaining a ±1% standard error when measuring moisture and max. 1 min. when measuring density. (Hung. Tech. Abstr.)

25688 FIRST ATTEMPT TO APPLY THE METHOD OF INVERSE PROBABILITIES TO THE PROCESSING OF RADIOMETRIC DATA. Tashev, N. G.; Tarkhov, A. G.; Nikitin, A. A. (Izv. Vyssh. Ucheb. Zaved. Geol. Razved., No. 9, 102-10(1966). (In Russian).

The theoretical possibility of using the inverse probability method in processing radiometric field data is assessed. Such processing can increase the depth of penetration of radioactivity prospecting methods and also yield more geological information compared to the usual interpretation methods. Anomalies of the same intensity as the noise level or as the mean square error of observation can be brought out with 95 percent confidence if there are a sufficient number of observations (9 to 11) in the anomalous zone. With the help of computers, processing time can be reduced to a minimum. (Geophys. Abstr.)

25689 MOISTURE CONTENT MEASUREMENT HAVING NEUTRON REFLECTING MATERIAL TO PROVIDE OPTIMUM COUNTING RANGE. Dresia, Heinrich; Fischotter, Peter; Bessing, Reinhold (to Rheinische Kalksteinwerke GmbH). U. S. Patent 3,350,561. Oct. 31, 1967. Filed Oct. 4, 1963.

A neutron-scattering system for measuring the moisture content of substances is described. A fast neutron source, a slow neutron detector, and a reflecting material such as a hydrocarbon comprise the system. Various configurations are illustrated. (W.H.K.)

25690 METHOD OF AND APPARATUS FOR MEASURING THE THICKNESS OF A WORKPIECE. (to Ceskoslovenske Zavody Gumarenske a Plastikarske). British Patent 1,111,103. Apr. 24, 1968. Priority date June 19, 1965, Czechoslovakia.

A radiometric instrument for measuring the thickness of a workpiece having a square weight of 4 to 20 kg/m^2 and with a low absorption coefficient, for example plastic tubes, is described. A combination of bremsstrahlung and beta radiation is used. (W.H.K.)

Miscellaneous Instruments and Components

Refer also to abstracts 25249, 25494, 25563, 25944, 26527–26529.

25691 (LMEC-Memo-68-3) LIQUID METAL IN-LINE IMPURITY MEASURING INSTRUMENTS (SODIUM) STATE-OF-THE-ART STUDY. Davis, K. A. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). Jan. 30, 1968. Contract AT(04-3)-700. 115p. Dep. CFSTI.

The development of plugging meters, electrochemical cells, diaphragm permeability separators, and resistance meters for in-line measurement of impurities in liquid metals is presented. (W.H.K.)

25692 (ORNL-TM-1638(Pt.14)) NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL. PART 14. PULSE AMPLIFIER AND COUNT RATE METER, ORNL MODEL Q-2614. DeLorenzo, J. T. (Oak Ridge National Lab., Tenn.). Feb. 28, 1968. Contract W-7405-eng-26. 43p. Dep. CFSTI.

The Pulse Amplifier and Count-Rate Meter amplifies and counts pulses from a fission chamber and preamplifier such as the ORNL Model Q-2617. The module consists of a pulse amplifier, a pulse-height discriminator, a logarithmic counting-rate meter of the Cooke-Yarborough type, a linear counting-rate meter, and two calibration oscillators (10 and 10^4 counts/sec). The unit is intended primarily for reactor control applications and is packaged in a standard "4 unit" plug-in module of the ORNL Modular Reactor Instrumentation Series. This report describes the circuit, applications, maintenance procedures, and acceptance tests for the Pulse Amplifier and Count Rate Meter. (auth)

25693 NUCLEAR SPIN-LATTICE RELAXATION MEASUREMENTS BY TONE-BURST MODULATION. Look, D. C.; Locker, D. R. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Phys. Rev. Lett., 20: 987-9(Apr. 29, 1968).

A method of accurately measuring both long and short nuclear spin-lattice relaxation times in liquids and solids using cw NMR spectroscopy is explained. A tone-burst generator is used, which feeds the tone-burst signal to the NMR probe's modulation coils through an amplifier which gives an output current proportional to the input voltage. The spin signal, after rf detection, may be displayed on an oscilloscope and photographed, or added repetitively in a signal enhancement device, triggered at the beginning of each tone burst. Also, a second modulation signal may be added through the amplifier if phase detection is desired. (C.E.S.)

25694 CURRENT INTEGRATING OR CHARGE MEASURING CONSIDERATIONS. Schreiner, R. S. (Keithley Instr., Cleveland). Electron. Ind., 25: 146-7; 9(May 1966).

Current integration or charge measurement methods are used for evaluation and measurement of random current pulses, laser energy, ion beams, and electron beams. These and other uses are reviewed and circuit considerations necessary for meaningful charge measurements are discussed. (Electron. Abstr. J.)

25695 DEVICE FOR COUNTING PULSES AND EVALUATING TIME INTERVALS. Tsepkov, G. V. Meas. Tech. (USSR) (Engl. Transl.), No. 2, 190-2(Feb. 1967).

An electronic computing and measuring device which can be used for measuring pulses in nuclear physics, as well as in electrophysiology, is described. The device described uses single-pulse and switching dekatrons (types OG-3 and A-101). The utilization of switching dekatrons simplifies the electric circuit and extends its field of application. This fact distinguishes it from existing commercial and individually produced instruments of a similar type. The main features of the circuit are a switching part and 2 identical counting channels, which allow it to operate in 2 conditions. In the counting condition the device can count, simultaneously over both channels, pulses which are either periodic or have a random distribution with respect to time. Each channel has a counting capacity of 10^5 pulses with a counting rate of 20,000 pulses/sec and a measurement error of ±1 pulse. In the time-interval measuring condition the device can count pulses over the first channel at a rate of 1000 pulses/sec with a counting capacity of 10^4 pulses and an error of ±1 pulse, at the same time it can determine over the second channel time intervals between any 2 arbitrary selected pulses (from 1 to 10) with an error not exceeding $\pm 0.05 \times 10^{-3}$ sec. The time interval of the measured pulses extends from 1×10^{-3} to 10^2 sec (in the latter case the final counting unit is connected to an electromechanical counter). The sensitivity of either channel to positive pulses is not less than 2 V for minimum pulse durations of 17 to 22 μsec. The circuit comprises 10 dekatrons, 8 double triodes, and 10 semiconductor diodes D7E. (BBB)

25696 WARNING CHIMES FOR EXPERIMENTAL X-RAY MACHINE. Murphy, E. G.; Stewart, H. F. (National Center for Radiological Health, Rockville, Md.). Health Phys., 14: 517-18 (May 1968).

An adaptation of a household door chime system which provides an effective warning device for a long exposure x-ray machine is described. The device proved more satisfactory than a nonaudible flashing light system. (UK)

25697 FLIPPER-CHOPPER FOR POLARIZED SLOW NEUTRONS. Steinsvoll, O.; Virjo, A. (Institutt for Atomenergi, Kjeller, Norway). Phys. Lett., 26A: 469-70(Apr. 8, 1968).

A conventional neutron spin resonance flipper for polarized slow neutrons has been rebuilt to allow pulsed flipper-chopper operation. It is then possible to use time-of-flight technique to obtain the energy of the scattered neutrons. The construction and results of experimental tests are briefly discussed. (auth)

25698 APPLICATIONS OF LOGIC MATRICES TO SOME PROBLEMS OF NUCLEAR PHYSICS. Neyron, Albert; Leproux, Gerard; Roy, Andre (CEN, Saclay, France). Automatisme, 12: 575-82(Dec. 1967). (In French).

Certain properties of logic circuits associated in a matrix structure are developed to show how logarithms may be calculated, and from these, products or quotients. The precision currently available is about 10^{-3} to 10^{-4} μsec. Several applications are indicated, particularly the development of a reciprocal code converter and the development of a logarithmic spectra tracer. These small units are suggested for small laboratories which have neither the financial means nor the specialized personnel to make constant use of commercial devices. Illustrations of actual equipment and block diagrams are given. (BBB)

25699 AN AUTOMATICAL DATA LOGGING AND PROCESSING SYSTEM FOR EXPERIMENTAL INVESTIGATIONS. II. Naray, Zs. (Zentralforschungsinstitut fuer Physik, Budapest). Kernenergie, 10: 325-30(Nov. 1967). (In German).

Some typical assemblies for the automatic logging and processing of data from experimental studies are described. One- and multi-dimensional analyzers, data centers, and the use of computers for measurement, control, and data processing are considered. Typical block diagrams are given of each. (J.S.R.)

25700 PORTABLE MULTI-PURPOSE NUCLEAR INSTRUMENT FOR USE IN MINING. Tari, L. Banyasz. Kut. Intez. Kozlem., 9: 389-97(1966). (In Hungarian).

The methane and dust content of air in mines can be determined, the surface density and moisture content of rocks as well as natural radioactivity can be measured by the joint use of nuclear detectors or of adequate radiation sources and detectors. The ionization potential difference of pure air and pure methane is used for measuring the methane content of air. Information in this case is yielded by the sensor in the form of current of 10^{-9} to 10^{-8} amp magnitude. An ionization chamber also is used for measuring the dust content of air, informations—here too—are yielded as currents of 10^{-9} to 10^{-7} amp magnitude. The surface density of rocks is established by measuring the Compton scattering of low-energy gamma rays or bremsstrahlung x-rays while their moisture content is determined by measuring the thermal neutrons obtained by the retardation of fast neutrons on hydrogen nuclei. Natural radioactivity is expediently measured with GM tubes or scintillation counters. Informations thus are received as currents, current or voltage pulses for the measurement of which an instrument has been developed at the Hungarian Institute for Mining Research. The instrument, supplemented by a system for pulse average measurement is capable of measuring direct currents of 10^{-9} amp magnitude over an impedance of max a few megohms. (Hung. Tech. Abstr.)

25701 DEVELOPMENT OF TWO-STAGE IMAGE INTENSIFIERS AND THEIR APPLICATIONS. Aslam, M. (Pakistan Inst. of Nuclear Science and Tech., Islamabad). Nucl. Sci. Appl., 3: 80-3(Oct. 1967).

The outstanding features of a magnetically focused cascade image intensifier are briefly stated. Its expected performance is compared with the experimental results obtained from the image tubes constructed in the laboratory. The improvements achieved are outlined. A brief survey of the applications of the image intensifiers in the field of scientific research is given and their applications in the field of nuclear physics are discussed. (auth)

25702 APPLICATION OF A VACUUM SPARK SOURCE MASS SPECTROMETER TO THE ANALYSIS OF IMPURITIES IN REACTOR MATERIALS. Swift, P.; Vossen, P. G. Th. Nucl. Energy, 46-52(Mar.-Apr. 1968).

Preliminary work on vacuum spark source mass spectrometry is described, and the limits of detection for various elements are discussed. Examples are given of the application to the analysis of steels, Li, Th, U, and Pu. Techniques are described for both conducting and insulating powders, and three alternative methods for analysing liquid samples are outlined. (UK)

25703 COMPARATIVE STUDY OF THE RETARDATION DEVICES OF ISOTOPE ELECTROMAGNETIC SEPARATORS. Dionisio, J. S.; de Lima, D. X. (CNRS, Orsay, France). Nucl. Instrum. Methods, 61: 260-84(May 15, 1968). (In French).

A semi-empirical method was used in the investigation of the optical properties of many electrostatic two-dimensional lenses employed in the retardation devices of the isotope separators. The potential distributions were measured with the electrolytic trough and conducting paper; the paraxial paths were calculated with the classical Gans method as well as the residual kinetic energy, the focal distance and the distance from the median plane to the focus. The spherical aberration of the equivalent unipotential lens was calculated for all the systems investigated. A generalization of the Gans method enables us to estimate the dependence of the paraxial paths and their optical parameters on the space charge interaction. A few systems are selected for further experimental tests. (auth)

25704 CALCULATION OF THE POLE FACE PROFILES OF INHOMOGENEOUS MAGNETIC FIELDS. Fabricius, H. (Zyklotron-Laboratorium, Karlsruhe, Ger.). Nucl. Instrum. Methods, 61: 251-2(May 15, 1968).

A formula is derived which gives the pole face profiles of inhomogeneous magnetic sector fields for preselected magnetic field parameters as a power series representation up to the fifth order. A way of solving the inverse problem (i.e., determining the magnetic field parameters for a given pole shape) is also pointed out. (auth)

25705 USE OF THE STATISTICAL PROPERTIES OF NOISE IN THE PROBLEM OF CURVE SMOOTHING. Nifenecker, H.; Perrin, G. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods, 61: 333-9(May 15, 1968). (In French).

The curve smoothing procedure described here is a modified version of the least-structure method. It takes profit of the known statistical properties of the noise superimposed to the curve of interest. In particular it tries to identify the autocorrelation function of the difference between the smoothed and unsmoothed curves to a white-noise autocorrelation function. (auth)

25706 A VERSATILE, LARGE-MEMORY PULSE-HEIGHT ANALYZER FOR GAMMA-RAY SPECTROMETRY. Euler, B. (Naval Radiological Defense Lab., San Francisco). Nucl. Instrum. Methods, 61: 311-16(May 15, 1968).

A 16384-channel pulse-height analyzer has been designed and built to achieve maximum benefit from any of several special detection systems. Although the analyzer was intended primarily for coincidence gamma-ray spectrometry, broader usage potentialities were recognized so that, in the design, features were included which make this instrument useful for a variety of measurements in radiochemical and nuclear physics research. Some important features are: (1) It can be used for the collection of either single- or two-parameter spectra, and provides for a wide selection of channel resolution in both applications; (2) In collection of singles spectra, a series of spectra can be collected in rapid sequence, and each spectrum held in the memory until the entire series has been collected; (3) A 16-position programmer makes it possible to specify a measurement sequence and to have it proceed automatically; (4) An identifying block of words can be composed and optionally inserted directly into the analyzer memory; (5) All or selected portions of the data can be inspected directly and easily; (6) Internal registers can be used for the selection of specific channels for display or for the summation of counts; (7) Punched-card and magnetic tape output options are available. (auth)

25707 SECOND-ORDER APPROXIMATION TO THE MAGNETIC FIELD OF MAGNETIZED CYLINDERS AND ANNULAR SHIMS. Danilov, V. I.; Ianovici, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods, 61: 301-10 (May 15, 1968).

The principal shortcoming of the method of computing the magnetic field of magnetized bodies upon the assumption of their uniform magnetization is the lack of numerical criteria on its accuracy and on its limits of applicability. It is shown, taking as example the vertical field component $H_z(r,z)$, that in computing the field of magnetized circular cylinders or cylindrical rings (annular shims) whose magnetic condition is near saturation, that it is necessary to consider a second-order approximation of the field) in the following regions of space: 1. For cylinders or annular shims for which $1 < (2h/R) < 10$, in planes whose distances from the boundaries of the cylinder are $z \leq h$ and $r \leq 2R$. 2. For long cylinders or annular shims $(2h/R) > 10$ only along the axis and in planes whose distance from the endface is $z \leq 0.2h$. (auth)

25708 MULTI-CHANNEL PULSEHEIGHT ANALYZER SPHA AND SPHA DIGITIZER (Engineering Materials). (California Inst. of Tech., Pasadena). (CAPE-1718).
13 drawings.

A twenty input 6- or 9-bit pulse height analyzer is described which consists of an SPHA stretching amplifier to generate stretched pulses with a flat top and an SPHAD time-to-digital converter designed to be read by a PDP-8 computer. The SPHA requires the application of a pulse called I-Control to produce an output whose length is proportional to the pulse height stored in the SPHA. The SPHAD treats the twenty inputs sequentially in pairs. In the 6-bit mode, the pair of answers are fed to the computer as a single 12-bit word, while in the 9-bit mode they are fed as two consecutive two 9-bit words. (For details see TID-4100 Suppl. 45) (F.S.)

25709 WAVELENGTH SHIFTING DEVICES (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE-1715).
5 drawings.

Two devices are described for use in automatically shifting the wavelength of a Beckman type DB Spectrophotometer. The devices use the rim of the wavelength wheel as a coupling point to drive the wheel. One device will position to two wavelengths by alternately driving the wheel against mechanically adjustable stops. The other device is a universal shifter in that the number of wavelengths is unlimited. (For details see TID-4100, Suppl. 45). (F.S.)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 25252, 25818, 25859, 25865, 25868, 25879, 25883, 25887, 25890, 25915, 25919, 25961, 25982, 25987, 25992, 26000, 26001, 26008, 26021, and 27526.

25710 (COO-78-163) ANNUAL REPORT FOR PERIOD ENDING JUNE 30, 1967. Friedell, Hymer L. (Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology). July 10, 1967. Contract W-31-109-eng-78. 140p. Dep. CFSTI.

Separate abstracts were prepared for the radiation physics, cytology, biochemistry, and physiology sections of the report. (B.S.L.)

For abstracts of individual sections see: 25711–25714.

25711 (COO-78-163, pp 1-38) RADIATION PHYSICS SECTION. (Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology).

ELECTRONS — energy loss in aluminum and polystyrene at 0.45 to 0.75 MeV
RADIOISOTOPE SCANNERS — development of scintillation
REPRODUCTION — radiation effects on, of cultured fibroblasts and lymphoblasts from mice, effects of dose, drugs, and metabolism on (B.S.L.)

25712 (COO-78-163, pp 39-63) RADIATION CYTOLOGY SECTION. (Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology).

ECHINODERMATA — Arbacia punctulata, radiation effects on eggs of, recovery from γ and uv
PROTEINS — synthesis during mitotic cycle of sea urchin eggs, effects of puromycin on
MITOSIS — radioinduced delay of, in sea urchin eggs, relation of, to centriole replication, γ
CYTOLOGY — analysis of organelles of mammalian cells and sea urchin eggs, evaluation of methods for
MYXOMYCOTA — Physarum polycephalum, characterization of satellite DNA from
NUCLEIC ACID, DEOXYRIBO — radiation effects on metabolism of, by protozoa, γ (B.S.L.)

25713 (COO-78-163, pp 64-125) RADIATION BIOCHEMISTRY SECTION. (Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology).

X RADIATION — effects on priming activity of DNA for DNA-nucleotidyltransferase; effects on transforming activity of DNA in Bacillus subtilis system; effects on chemical and physical properties of DNA
NUCLEIC ACID, DEOXYRIBO — replication in Physarum polycephalum biochemical analysis of
GAMMA RADIATION — effects on metabolic processes associated with nuclear division in synchronously dividing slime mold
NUCLEIC ACID, RIBO — radiation effects on synthesis of, in slime mold, ionizing
CELLS — radiation effects on protein metabolism in synchronous cultures of Chinese hamster, in relation to reproduction, ionizing
TRACER TECHNIQUES — use for detection and quantitation of proteins synthesized during mitotic cycle
ELECTROPHORESIS — use for detection and quantitation of proteins synthesized during mitotic cycle (B.S.L.)

25714 (COO-78-163, pp 126-36) RADIATION PHYSIOLOGY AND MODIFIERS SECTION. (Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology).

X RADIATION — effects on cultured Chinese hamster ovary cells, effects of Crabtree effect on
RADIOISOTOPE SCANNING — development of labeled compounds for medical
BUTYRIC ACID, 2-AMINO-4-(METHYLSELENYL) — uptake of selenium-75 labeled, by abdominal organs of guinea pigs
BLOOD — scanning of myocardial circulation of, evaluation of cesium-131 labeled compounds for
BRAIN — scanning of, evaluation of labeled compounds for
FLUORESCENCE — emission of reduced pyridine nucleotides, effects of glucose on (B.S.L.)

25715 (NYO-1371-51) GENETIC TRANSFORMATION IN HEMOPHILUS INFLUENZAE. Three Year Comprehensive Report, September 15, 1964–September 14, 1967. Herriott, Roger M. (Johns Hopkins Univ., Baltimore, Md. Dept. of Biochemistry). Contract AT(30-1)-1371. 15p. Dep. CFSTI.

GENETIC TRANSFER — reaction mechanisms of transformation, in Hemophilus influenzae
COMPETENCE, GENETIC — development in Hemophilus influenzae, analysis of
CULTURE MEDIA — content of defined, for development of competence in Hemophilus influenzae
THYMIDINE — uptake by DNA of Hemophilus influenzae, tracer study of
THYMINE — uptake by DNA of Hemophilus influenzae, tracer study of
PHOTOREACTIVATION — isolation and purification of enzymes for, in yeasts, method for batch; inhibition in Hemophilus influenzae by amino acids and chloramphenicol
NUCLEIC ACID, DEOXYRIBO — infectivity of Hemophilus temperate H1C1 phage and prophage
CHROMOSOMES — genetic markers of, method for determination of distribution of
ULTRAVIOLET RADIATION — effects on transforming DNA of Hemophilus influenzae, effects of host-cell reactivation on assay of (H.L.W.)

25716 (NYO-3538-7) PROGRESS REPORT [ON PHYSICAL BINDING AND CHEMICAL LINKAGE OF 3,4-BENZPYRENE TO NUCLEIC ACIDS], JUNE 1965–MARCH 1968. Ts'o, Paul O. P. (Johns Hopkins Univ., Baltimore, Md.). Mar. 1, 1968. Contract AT(30-1)-3538. 7p. Dep. CFSTI.

BENZO(A)PYRENE — binding to nucleic acids, nucleoproteins, nucleosides, and nucleotides; radiation-induced linkage of, to nucleic acids, photo-; radiation-induced linkage of, to nucleohistones, photo-; linkage to DNA induced by free radicals from redox system; radioinduced linkage of, to DNA, x
NUCLEIC ACIDS — conformation and interaction of, effects of hydrophobic-stacking force on; replication errors in RNA polymerase system in
NUCLEOTIDES — interactions with nuclease, model for specific protein-nucleic acid interaction in

25717 (NYO-3859-1) BIOLOGICAL APPLICATIONS OF MOSSBAUER SPECTROSCOPY. Progress Report, May 1967–February 1968. Epstein, L. M.; Straub, Darel K. (Pittsburgh Univ., Pa. Dept. of Chemistry). Contract AT(30-1)-3859. 72p. Dep. CFSTI.

Data from Moessbauer spectroscopy, nuclear magnetic resonance spectroscopy, and low-temperature magnetic susceptibility measurements were collected for a number of five-coordinated ferric porphyrins, including halo, thiocyano and hydroxo derivatives. It appears from such data that there is antiferromagnetic coupling between iron ions in the ferric porphyrin hydroxides, perhaps by dimerization through bridging oxide ions. Some known dimeric ferric complexes containing bridging or hydroxide were also investigated. An extensive series of tris(N,N-disubstituted dithiocarbamato)iron(III) compounds and halo (and thiocyano) bis(N,N-di-substituted dithiocarbamato)iron(III) compounds were prepared and their Moessbauer spectra obtained. There is marked dependence of the quadrupole splitting on temperature and the nitrogen substituents for the tris dithiocarbamate series, that supports the postulate of a thermal equilibrium mixture of low and high spin states of the iron(III). Such a dependence is not shown by the bis dithiocarbmates, which contain five-coordinated iron(III) in a quartet ground state. Several thiocyanobis(N,N-disubstituted dithiocarbamato)iron(III) complexes were prepared for the first time. (auth)

25718 (ORO-2410-9) THE INFLUENCE OF NITROGEN NUTRITION ON ACCUMULATION OF CESIUM AND STRONTIUM BY HIGHER PLANTS. Annual Progress Report, May 1, 1967–April 30, 1968. Jackson, William A. (North Carolina State Univ., Raleigh. Dept. of Soil Science). Jan. 1968. Contract AT(40-1)-2410. 36p. Dep. CFSTI.

Progress is reported on a study on nitrate uptake by nitrogen-deficient wheat seedlings, metabolic alterations of roots induced by ammonium and nitrate during initial recovery from nitrogen-depletion, and the effects of ammonium and nitrate uptake during recovery from nitrogen-depletion on the uptake of Sr in roots and transport to plant tissues. Results are reported from studies in which ^{14}N-nitrate, ^{15}N-nitrate, $Ca(^{15}NO_3)_2$, $Ca(^{14}NO_3)_2$, acetate-1-^{14}C, pyruvate-^{14}C, and ^{85}Sr were used as tracers. (C.H.)

25719 (ORO-2410-10) THE INFLUENCE OF NITROGEN NUTRITION ON ACCUMULATION OF CESIUM AND STRONTIUM

BY HIGHER PLANTS. Three Year Summary Report, May 1, 1965–April 30, 1968. Jackson, William A. (North Carolina State Univ., Raleigh. Dept. of Soil Science). Jan. 1968. Contract AT(40-1)-2410. 27p. Dep. CFSTI.

Progress is reported on studies of the influence of nitrogen nutrition on the uptake and transport of Sr in wheat seedlings. Results are reported from: studies on the effects of nitrates on Sr uptake and transport to shoots; the effects of ammonium and nitrate availability on uptake patterns; metabolic sequences in nitrogen-depleted root tissues that result in Sr accumulation; the effect of Ca availability on Sr uptake; and tracer studies of respiratory patterns induced by nitrate and ammonium uptake. (C.H.)

25720 (ORO–3630-2) RADIOBIOLOGY OF RNA AND DNA BACTERIOPHAGES: PHOTOREACTIVATION. Progress Report. Werbin, Harold (Southwest Center for Advanced Studies, Dallas, Tex.). Jan. 2, 1962. Contract AT(40-1)-3630. 20p. Dep. CFSTI.

A photoreactivating enzyme was identified and purified from the blue-green alga, Plectonema boryanum. The enzyme is being concentrated from crude extracts by using acetone precipitation and calcium phosphate gel adsorption. Procedures for growth of algal cultures, methods of improving the enzymatic bioassay, and methods of preparing active cell-free extracts are described. The effects of uv irradiation on the extracellular infective process were determined by infecting Escherichia coli with uv-irradiated ^{32}P-labeled RNA phage f2 and applying quantitative methods for adsorption, transfer, and penetration of the phage and its RNA. The extent to which replication of the phage genome was impaired by uv light was determined by irradiating ^{32}P-f2 for varying time intervals, allowing it to infect E. coli, and extracting and analyzing for the replicative form. The virus LPP-1 in the alga, Plectonema boryanum, was grown in the presence and absence of caffeine and acriflavine, inhibitors of host cell reactivation and dark repair. Survival of the virus was reduced in the presence of the inhibitors. Results are shown in the form of tables and graphs. A list of 21 references is included. (H.L.W.)

25721 (UCLA–12-668) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1967. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Dec. 31, 1967. Contract AT(04-1)-Gen-12. 84p. Dep. CFSTI.

Separate abstracts were prepared for the five sections of this report. (H.L.W.)

For abstracts of individual papers see: 25722, 25723, 25800, 25859, and 25860.

25722 (UCLA–12-668, pp 59-69) BIOCHEMISTRY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

LIPIDS—content of glial cells isolated from white matter in cattle
ESTERS—biosynthesis of wax, in fish
FATTY ACIDS—radiolysis of saturated
SCHIZOMYCOTA—Bacillus sp., biosynthesis of unsaturated fatty acids in
HEART—development of cells of, in culture, effects of myosin ATPase levels on
GAMMA RADIATION—effects on heart cell cultures, effects of colchicine on
ENZYMES—content of beating heart cells, effects of serum lipids on (H.L.W.)

25723 (UCLA–12-668, pp 71-84) RADIOBIOLOGY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

NUCLEIC ACID, DEOXYRIBO—reactions with hydroxyl radical, determination of, by pulse radiolysis; radiolysis of aqueous solutions of, effects of chloride ion on
FREE RADICALS—formation by reaction of nucleotides with hydrogen atoms, determination of, by ESR
NUCLEOTIDES—polymers of, radioinduced degradation of aqueous solutions of, γ
MYELIN—radiation effects on molecular composition of, in rats, effects of age on x
CELLS—synthesis of proteins in organelles of
BRAIN—radiation effects on DNA in, of rats, effects of enzymes on x; regulation of glycerolphosphate dehydrogenase in, of rats, by hormones
PEROXIDASE—conformation of, use of circular dichroism for determination of
SPECTRA—resolution of circular dichroic, use of computer of average transients for
ERYTHROPOIETIN—inhibition by normal plasma
DISEASES, NEOPLASTIC—Ehrlich ascites tumor, radiation effects on, of mice, effects of glyceraldehyde and methylglyoxal on γ (H.L.W.)

25724 INTERACTION OF SOME METAL IONS WITH THE UTERUS OF THE GUINEA PIG. Spruit, D.; Kuiper, J. P. (Roman Catholic Univ., Nijmegen, Netherlands). Acta Physiol. Pharmacol. Neer., 14: 434-42(Dec. 1967).

Addition of Ni^{++} or $(UO_2)^{++}$ up to a concentration of 0.1 to 1 mmole/l caused contraction of the uterus suspended in Tyrode solution, but Co^{++} did not contract the uterus even at higher concentrations. The contraction produced by Ni^{++} could be repeated, unless very low concentrations were added within a short time. Both maximum contraction and maximum adsorption occurred at about 1 mmole Ni^{++}/l. Uranyl ion acted similarly. The presence of Co^{++} in the uterus decreased the contraction produced by Ni^{++} to some extent and at the same time less Ni^{++} was adsorbed. Previous contact of the uterus with Co^{++} did not prevent contraction by Ni^{++} after the Co^{++} had been rinsed from the uterus. The metal ion was adsorbed by the uterus within three min but it penetrated much more slowly into the interior. Only minor amounts of Ni^{++} were adsorbed at pH 5, compared with pH 7.5. A uterus which had been stimulated by Ni^{++} could not be regenerated, even by the addition of the complexing agent EDTA. (BBB)

25725 CYTOCHEMICAL STUDY OF THE EFFECT OF IONIZING RADIATION ON THE ONION EPIDERMIS. Brucker, W.; Schultz, Barbara (Univ., Griefswald, Ger.). Wiss. Z. Ernst-Moritz-Arndt-Univ. Griefswald, Math.-Naturwiss. Reihe, 15: 125-35(1966). (In German).

The third layer of the epidermis of Allium cepa was x irradiated for periods of time ranging from 20 sec to 26 min at rates of 38,500 to 296,000 R/min. Total doses ranged from 100 to 1200 KR. The lowest dose at which cells were observed to die after irradiation was 100 KR. The samples were studied in bright field with phase contrast and by fluorescence microscopy. The radiosensitivity of the layers increased from outer to inner portions, and most of the injuries observed appeared to be dose dependent. The 100% lethal dose was 1000 KR. At the lower doses the irradiation injuries appeared randomly within the tissues, and seemed to be related to the time interval between irradiation and staining and observation. The fractions of cells damaged at doses of 100, 200, 300, and 400 KR amounted to 4, 39, 56, and 79%, when studied with acridine orange at four or 20 hr after irradiation. When stained one day after irradiation the fractions of cells damaged at 600, 700, 800, 900, 1100, and 1500 KR amounted to 58, 67, 79, 91, 95, and 100%, respectively. Alterations of the dehydrogenase enzyme systems were studied by means of triphenyl tetrazolium chloride reagent and degree of cytoplasmic streaming. The microsomes were readily stained, but the mitochondria were not. At 100 KR there was no apparent change from normal. At 200 KR cytoplasmic streaming was evident in 90% of the cells. At 500 KR it amounted to 50%, at 700 KR, it was 5 or 10%, and at 1000 KR cytoplasmic streaming did not appear in any cells. (BBB)

25726 FREE HISTAMINE LEVEL CHANGES IN TISSUES OF RATS IRRADIATED WITH HIGH-ENERGY PROTONS, GAMMA RAYS, AND FISSION NEUTRONS. Kudryashov, Yu. B.; Bilushi, S. G.; Goncharenko, E. N.; Filenko, O. F. Nauch. Dokl. Vyssh. Shk., Biol. Nauki, No. 4, 61-3(1967). (In Russian).

White male rats weighing 120 to 150 g were irradiated with high energy protons (500 rad/min), fission neutrons (100 rad/hr) and gamma rays (50 rad/min) in single doses corresponding to 300, 700, and 1500 R to determine free histamine level changes with different linear energy loss values. Following irradiation, histamine levels of the kidneys, shin and liver were determined at periods of 5 to 10 min, 20 to 40 min, 1 hr, 1 day, 3 days, and 7 days. Findings show that all three types of radiation in doses equivalent to 300 were not lethal. Radiation doses equivalent to 700 R induced death in all the experimental animals within 30 days (radiation sickness). With 1500 R doses all animals died of acute radiation sickness within an average of 3.5 days. Free histamine changes were found only with 700 and 1500 R doses; no reliable histamine changes were found for 300 doses. No definite correlation was found between histamine level increase and a given type of radiation. Histamine changes were characterized by increased levels in all tissues shortly after irradiation and then a decrease. Analysis of the data demonstrated a similarity in free histamine levels for equivalent doses of high density and low density ionizing radiation. (ATD)

25727 RADIATION AS A POSSIBLE COAGULATION AID. Smith, Willard Mac Jr.; Ledbetter, Joe O. Water Sewage Works, 114: 496-7(Dec. 1967).

The stabilization of negatively charged colloids was demonstrated several decades ago in a study of Cu, Ag, and Au sols exposed to Ra γ rays and neutrons from a Ra-Be source. The evidence indicated that negatively charged colloids were first stabilized, then destabilized, and then stabilized again as the radiation dose increased. The change in zeta potential was de-

pendent on particle size, nature of the sol, and type of radiation employed. Since the flocculation in water purification procedures, produced by adding alum to a colloidal suspension, was due to a reduction in the zeta potential brought about by the trivalent Al ions in solution, there was a possibility that the two effects of irradiation and alum might be cumulative and that a dose of radiation which lowered the zeta potential of the kaolinite would also lower the dose of alum required to bring about coagulation. Some experiments were performed to test the hypothesis that this effect on the zeta potential by irradiation might be used to reduce the amount of chemical flocculant (alum) necessary to bring about coagulation of the colloids causing turbidity in drinking water. Kaolinite was chosen as a typical colloid, and irradiation of the samples was done with a 0.6-Ci ^{60}Co source. The effectiveness of radiation doses from 0 to 300 R was measured by adding alum to the irradiated sample and comparing the turbidity with an unirradiated sample given an equal dose of alum. Runs were carried out just above the minimum coagulating dose of alum (at 1.35 meq/l), just below (at 0.9 meq/l), and at the minimum dose for uniformly complete coagulation (1.5 meq/l). It was found that irradiation of the kaolinite suspension, within the dose range used, neither raised nor lowered significantly the amount of alum required to bring about coagulation of the suspension. Irradiation did produce a sort of instability which affected the results from the intermediate alum dose (1.35 meq/l) in regard to the completeness of coagulation. Unfortunately, the effect seen was too small and too erratic to be useful for water treatment purposes, particularly when an 11% larger alum dose (1.5 meq/l) ensured uniformly complete coagulation. (BBB)

25728 LYMPHOTAXIS INDUCED BY ULTRAVIOLET MICROBEAM IRRADIATION OF FIBROBLASTS IN TISSUES CULTURED FROM MOUSE EMBRYOS. Amenta, Peter S. (Hahnemann Medical Coll., Philadelphia). Anat. Rec., 159: 199-210(Oct. 1967).

When portions of the cytoplasm of fibroblasts cultured from mouse embryo tissues were irradiated with heterochromatic microbeams of uv light, lymphocytes were attracted (lymphotaxis) to the injured areas. The lymphocytes approached in the hand-mirror shape characteristic of tissue cultures. On reaching the fibroblast, pseudopodia shot out to lick the wound and then the lymphocyte wormed its way across the cell. Only one lymphocyte contacted a fibroblast after uv irradiation but the same one sometimes made several passes. It was postulated that lymphocytes were cleaning the wounded area of undesirable uv irradiation products and/or applying healing substances to the wounded fibroblast. The uv irradiation of lymphocytes in portions of the cytoplasm failed to evoke responses from nearby lymphocytes. Instead, the cytoplasm whirled around the nucleus as if the irradiation products could not leave the cell, resulting in convulsions and death. A technique was described by which relatively pure cultures of lymphocytes could be obtained from leukocyte cultures by selectively killing all granular leukocytes with excessive exposure to microbeams of uv light. Lymphocytes were harvested and introduced into fibroblast cultures to study experimental lymphotaxis. (BBB)

25729 RADIAL EXCHANGE OF LABELED WATER IN MAIZE ROOTS. Jarvis, P.; House, C. R. (Univ. of East Anglia, Norwich, Eng.). J. Exp. Biol., 18: 695-706(Nov. 1967).

The efflux kinetics of ^3H_2O was studied in isolated maize roots to identify the rate-limiting step in this radial exchange process. Although the efflux curve of ^3H_2O could be mathematically described by the solution of an appropriate cylindrical diffusion problem, other experimental evidence was incompatible with this model. It was considered that the efflux kinetics of ^3H-labeled water resulted from the characteristics of membrane penetration in a heterogeneous multicellular preparation like the root. On this basis, it was computed from the efflux curve that the typical membrane permeability of root cells to ^3H_2O was about 4.5×10^{-6} cm/sec^{-1}. Similar efflux studies were performed on dead roots, prepared by boiling the normal excised roots for a short time. These experiments indicated that the solution, obtained from a cylindrical diffusion analysis, represented a satisfactory description of the exchange of ^3H_2O in dead roots. A common feature of both efflux curves for normal and dead roots was that each deviated significantly from the theoretical diffusion curves for large values of time. The precise origin of these deviations was not determined but they did reflect some property of the root tissue. (BBB)

25730 ANTI-TUMOR ACTIVITY OF AN UNSATURATED FATTY ACID EXTRACTED FROM IRRADIATED RABBIT LIVER. PART I. EFFECT ON LYMPHATIC ASCITES LEUKEMIA IN DBA MICE. Watanabe, Terutugu (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 79: 211-17(Apr. 1967). (In Japanese).

The anti-tumor activity of OX substance, an unsaturated fatty acid extract of rabbit liver 24 hr after 3000 R γ irradiation, was studied in lymphatic ascites leukemia (methylcholanthrene induced) in DBA mice. OX substance was administered intravenously via the tail vein of the mice. Red blood cell and white blood cell counts in the peripheral blood, extent of ascites and morphological changes of ascites cells, pathological findings of the visceral organs, body weight, and survival time of the mice were observed. Administration of OX substance resulted in prevention of anemia and suppression of development of leukemia in DBA mice with ascites leukemia. OX substance had no influence on changes of body weight of DBA mice with ascites leukemia. The life span was markedly prolonged by OX substance administration; the infiltration of leukemia cells into the lung, liver, spleen, and other organs was inhibited. It also exerted a strong cytotoxic effect on the ascites leukemia cells in DBA mice. (BBB)

25731 ANTI-TUMOR ACTIVITY OF AN UNSATURATED FATTY ACID EXTRACTED FROM IRRADIATED RABBIT LIVER. PART II. EFFECT ON LYMPHATIC ASCITES LEUKEMIA IN CBA MICE. Watanabe, Terutugu (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 79: 219-26(Apr. 1967). (In Japanese).

Anti-tumor activity of OX substance was studied in the lymphatic ascites leukemia in CBA mice, induced by successive transplantation of ascites cells of DBA mice. Administration of OX substance resulted in prevention of anemia and suppression of development of leukemia in DBA mice with ascites leukemia. OX substance had no influence on changes of the body weight of DBA mice with ascites leukemia. Life span of DBA mice was remarkably prolonged by OX substance administration. OX substance inhibited the infiltration of leukemia cells in the lung, liver, spleen, and other organs of DBA mice. It exerted a strong cytotoxic effect on the ascites leukemia cells in DBA mice. OX substance had no influence on the blood picture of the normal rabbit. (BBB)

25732 VACCINATION AGAINST LEPTOSPIROSIS: PROTECTION OF HAMSTERS AND SWINE AGAINST RENAL LEPTOSPIROSIS BY KILLED BUT INTACT GAMMA-IRRADIATED OR DIHYDROSTREPTOMYCIN-EXPOSED LEPTOSPIRA POMONA. Stalheim, O. H. V. (Agricultural Research Service, Ames, Iowa). Amer. J. Vet. Res., 128: 1671-6(Nov. 1967).

The immunogenicity of experimental immunizing agents was tested in hamsters and swine by challenging their immunity with renaltropic strains of Leptospira pomona. Killed L. pomona organisms, fixed with osmium tetroxide that preserved intact the morphologic components, did not protect hamsters or swine against renal leptospirosis. The motility of L. pomona was not impaired by exposure to 10^4 or 10^5 rads of γ radiation, but the organisms were made nonreplicating. Standardized suspension of motile, respiring L. pomona made nonreplicating by exposure to γ rays of dihydrostreptomycin did not grow in vitro and did not initiate leptospiral infections in hamsters or swine, but conferred them with different degrees of immunity to renal leptospirosis. Gamma irradiated L. pomona protected 11 of 20 vaccinated hamsters and 12 of 14 vaccinated swine; dihydrostreptomycin-exposed L. pomona protected 4 of 20 vaccinated hamsters and all (7) vaccinated swine. Leptospires were isolated from the kidneys of all control hamsters and swine. (auth)

25733 MUSCLE BLOOD FLOW AND ^{86}Rb EXTRACTION: ^{86}Rb AS A CAPILLARY FLOW INDICATOR. Friedman, J. J. (Indiana Univ., Indianapolis). Amer. J. Physiol., 214: 488-93(Mar. 1968).

The relation between blood flow and ^{86}Rb extraction was examined in the isolated gracilis muscles of dogs, pump perfused at constant flow, over a range of blood flow from 0.5 to 12.0 ml/min per 100 g, under control conditions, following papaverine administration and following restoration of blood flow after a period of 4-min flow interruption (arterial occlusion). Semilogarithmic plots of extraction versus flow provided a straight line with a negative slope. The mean control slope of 0.059 ± 0.017 (SD) indicates that Rb extraction is inversely related to blood flow. The mean slope of 0.032 ± 0.009 (SD) with papaverine reflects the participation of active vascular adjustment and flow redistribution in the establishment of this relationship. The remaining slope reflects differences in physical properties of capillary and shunt circuits. Arterial occlusion provides a mean slope of 0.022 ± 0.014 (SD) with some slopes as low as 0.0027. These very low slopes demonstrate very slight interaction between flow and extraction and support the concept of flow-limited exchange of Rb in the capillary circuit and no significant Rb exchange in the shunt circuit. Thus ^{86}Rb can function as a quantitative capillary blood flow indicator. (auth)

25734 EFFECT OF HIGH-POWER RUBY LASER IRRADIATION ON PERIPHERAL NERVE. Hoegberg, Lars; Reinius,

Staffan; Stahle, Jan; Vogel, Klaus; Wallin, Gunnar (Univ. Hospital, Uppsala). Acta Soc. Med. Upsal., 72: 105-19(1967).

The effects of a Q-switched ruby laser with a power density of 4×10^{10} W/cm^2 on isolated sciatic nerves of the toad were studied. Tissue eruption appeared at the impact point, which under light-microscope examination showed a well-defined capsule rupture with bulging of the nerve fibers. Electron-microscope examination showed alterations in the myelin sheaths and axon. The action potential in the nerve after laser irradiation was almost completely blocked. Rupture in the epineurium, with expulsion of the nerve fibers, was observed by light microscopy. No clear morphological interruption of the nerve continuity was shown. The lesion was about 0.5 mm in diameter and could be followed through the entire thickness of the nerve. In electron micrographs the lesions of the irradiated nerves differed at varying depths beneath the surface. In the outer nerve-fiber layer the myelin sheath had split and vacuoles were seen between the separate lamellae. The axon had a dense appearance. No specific alterations in the mitochondria and the endoplasmic reticulum could be observed. In the first underlying layer of nerve fibers the myelin sheaths were thickened and formed irregular bulges into the axon. In the connective tissue between the outer and the first underlying layer, osmophilic, irregular membrane structures were seen. Deeper-lying nerve fibers (5 to 10 layers from the outer layer) showed no definite alterations. (BBB)

25735 DEPIGMENTATION OF HAIR IN C57BL MICE AFTER INJECTION OF IRRADIATED THYMIC RNA. Sato, Chikako; Sakka, Masatoshi (Tohoku Univ., Sendai). Tohoku J. Exp. Med., 93: 23-30(Sept. 1967).

The effects of changes induced in RNA molecules by irradiation on the depigmentation of hair were studied. Thymus RNA of C57BL mice extracted by the Na dodecyl sulfate-phenol method was irradiated with 10^6 R of ^{60}Co γ rays. After exposure, Sephadex column chromatography revealed that 27.7% of the original RNA was decomposed to smaller molecules with molecular weights below 10,000. When the irradiated solution was injected subcutaneously into newborn mice of the same strain, white hairs were observed in the fur of the mice. The difference in the proportion of depigmented hairs between two groups injected with irradiated and nonirradiated RNA, respectively, was statistically significant. In later hair generations, white hairs were replaced by darker ones. A variation in the pigment content of cortical cells of dark hairs was also observed. (BBB)

25736 RELATION BETWEEN THE CLEARANCE OF IODIDE AND PERTECHNETATE IN HUMAN PAROTID SALIVA AND SALIVARY FLOW RATE. Harden, R. McG.; Alexander, W. D. (Western Infirmary, Glasgow). Clin. Sci., 33: 425-31(Oct. 1967).

A linear relation between parotid salivary radioiodide clearance and salivary flow rate was demonstrated in four subjects studied at flow rates ranging from 0.03 to 4.1 ml./min. In 26 subjects the parotid salivary radioiodide clearance was studied at three flow rates and ranged from 4.1 ± SEM 0.57 ml./min. under resting conditions to 14.9 ± SEM 1.43 ml./min. during lemon juice stimulation. Clearance of pertechnetate ($^{99m}TcO_4^-$) was measured at the same time as the radioiodide clearance. As the flow rate increased so did the $^{99m}TcO_4^-$ clearance, values ranging from 2.2 ± SEM 0.28 ml./min. under resting conditions to 7.1 ± SEM 0.63 ml./min. during lemon juice stimulation. The ratio of I^- clearance to TcO_4^- clearance did not vary with flow rate and at all flow rates the TcO_4^- clearance was about half the I^- clearance. These results are consistent with TcO_4^- and I^- sharing a common transport mechanism. In any study of salivary I^- or TcO_4^- clearance, flow rate of saliva must be considered. Variations in the saliva/plasma ratios at resting flow rates are significantly greater than variations in the clearance rate. (BBB)

25737 IMMUNOLOGICAL CONTROL OF A TRANSPLANT OF DONOR TISSUE IN A RADIATION CHIMERA. Zaretskaya, Yu. I.; Petrov, R. V. (Inst. of Biophysics, Moscow). pp 304-12 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The recipients irradiated were CBA mice three to four months old (males and females); the donors of bone marrow cells were Wistar rats weighing 30 to 40 g. The mice received a γ-ray dose of 900 R at the rate of 310 to 320 R/min ($LD_{100/11}$ for animals not protected by marrow) and on the next day, each received an intravenous injection of 3.2 to 3.4×10^7 viable nucleus-containing cells. In one to three weeks 60 to 70% of the chimeras protected by the heterologous marrow died. Survivors were used to investigate the effect of antiserum and sensitized cells on donor growth. The administration of the antiserum reduced the growth activity of the transplanted cells and the sensitized cells completely suppressed growth for six days. Results indicated the possibility of immunological control of the state of a transplant of donor tissue in a chimera. (JPRS)

25738 EFFECT OF FREE RADICALS OF WATER AND ORGANIC SUBSTANCES ON YEAST CELLS. Klinson, N. A.; Momedov, T. G. (Inst. of Medical Radiology, Obninsk, USSR). pp 103-8 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Organic radicals obtained by oxidation of OH and HO_2 in polyphenols and amino acids, were added to aqueous suspensions of 2 to 3-day cultures of Saccharomyces vini strain Megri 139-B that were kept at room temperature. The reaction was halted at various times by 100-fold dilution with water and washing of the cells. The cells were then incubated on a nutrient medium at 30°C and their survival determined on the basis of microcolonies. It was found that the free radical products of decomposition of OH and HO_2 and the organic free radicals initiated by them were highly injurious to yeast cells; the effectiveness of the organic radicals was considerably greater. Oxygen intensified the action of the organic radicals but not that of the water radicals. (JPRS)

25739 THE POSSIBLE ROLE OF FREE RADICALS AND THEIR INACTIVATION IN RADIATION INJURY OF YEAST CELLS AND IN THE PROCESSES OF POSTIRRADIATION RECOVERY. Karabaev, E. M.; Kozlov, Yu. P.; Korogodin, V. I. (Inst. of Medical Radiology, Obninsk, USSR. Moscow State Univ.). pp 96-103 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Aqueous suspensions of diploid yeasts, Saccharomyces vini strain Megri 139-B, were irradiated at doses of 30 to 86 kR at a dose rate of about 1000 R/minute. The irradiation caused damage to the elementary structures and the formation of a certain quantity of products, probably active free radicals. These caused additional postirradiation injury that was not great when compared with the total effect of irradiation. The additional injury caused by these products was not stable and proceeded rapidly even under anoxic conditions; ordinary postirradiation recovery did not occur under anoxic conditions. If radiation injury of a free-radical type played a role in the lethal effects of irradiation on yeast cells, it was an insignificant one. (JPRS)

25740 THE NATURE OF POSTIRRADIATION RECOVERY. I. DEFINITION AND GENERAL CHARACTERIZATION OF THE PROCESS. Paribok, V. P. (Inst. of Cytology, Moscow). pp 20-5 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Postirradiation recovery, defined as the process of elimination of overt or latent radiation injury, is considered on the molecular, cellular and population levels. A hypothesis was advanced that the recovery process had a role in maintaining the integrity of genetic structures during the normal vital activity of the cell, i.e., when it is not subjected to radiation or other mutagenic effects. (JPRS)

25741 EXTRACORPOREAL IRRADIATION OF THE BLOOD IN RENAL HOMOGRAFT REJECTION. Maginn, R. Reilly (Cambridge Univ., Eng.); Bullimore, Jill A. Brit. J. Radiol., 41: 127-33(Feb. 1968).

Extracorporeal irradiation (ECI) using a ^{90}Sr source proved to be a convenient and easy tool for the production of a significant lymphopenia in both dogs and humans. No untoward side effects, complications, or biochemical derangements were noted following the use of ECI. A striking reduction in the number of lymphocytes in the spleen and lymph nodes was noted after daily courses of ECI. ECI proved effective in reversing the early or acute rejection phenomenon following transplantation of kidneys in two human patients. It had little or no effect on the late rejection process, that is characterized by an arterial endothelial proliferative lesion. If the present hypothesis concerning the modes of sensitisation of a host to foreign antigens is correct, ECI would seem to have a significant potential in reducing the late rejection phenomenon. (auth) (TSS)

25742 THE EFFECT OF IRRADIATION BY IONIZING RADIATION ON MILK ENZYMES. III. EFFECT OF IRRADIATION ON LIPASE AND XANTHINE OXIDASE ACTIVITIES IN MILK. Tsugo, Tomokichi; Hayashi, Toshio (Tokyo Univ.). Nippon Chikusangaku Kaiho, 33: 125-9(June 1962). (In Japanese).

The effects of ^{60}Co γ rays, sunlight, and artificial (visible) light on some milk enzyme activities were studied. It was observed that lipase was very sensitive to all such irradiations, and that 70% of its activity was inactivated by γ irradiation of 0.66 MR. It was demonstrated by the Frankel and Tarassuk method (using trybu-

tyrin as substrate) that milk lipase has nearly the same heat resistance as milk phosphatase. These determinations were carried out with a Warburg manometer by use of a method in which the Ball and the Beiler and Martin techniques were combined. Milk xanthine oxidase was found to have a greater radiation resistance compared with that of phosphatase and a greater heat-resistance compared with that of milk peroxidase. The main reason for xanthine oxidase being more radioresistant than peroxidase could be that it is an oxidation-reduction enzyme. The fact that milk xanthine oxidase was absorbed on the fat globules in milk could also partially account for its relatively high radioresistance. (BBB)

25743 THE MEASUREMENT OF GLOMERULAR FILTRATION RATE AND EFFECTIVE RENAL PLASMA FLOW IN MAN BY IOTHALAMATE-^{125}I AND IODOPYRACET-^{131}I. Elwood, Charles M.; Sigman, Eugene M. (State Univ. of New York, Buffalo). Circulation, 36: 441-8(Sept. 1967).

A dual-channel pulse-height analyzer was used in the development of a double-isotope technique employing ^{125}I and ^{131}I for the measurement of glomerular filtration rate (GFR) and effective renal plasma flow (ERPF). In 21 patients, 90 simultaneous renal clearances of inulin and sodium iothalamate-^{125}I, and p-aminohippuric acid (PAH) and iodopyracet-^{131}I were determined by a constant infusion technique. The activities of iothalamate-^{125}I and iodopyracet-^{131}I were determined simultaneously after injection of 0.5 μCi/Kg amounts of each. Inulin and PAH were determined by standard chemical techniques. The ratio of iothalamate-^{125}I to inulin clearance ranged from 0.93 to 1.09 with a mean of 1.00. The ratio of iodopyracet-^{131}I to PAH clearance varied from 0.86 to 1.04 with a mean of 0.96. The chemical determination of PAH and inulin required ~8 hr compared with 30 min by the radioisotope technique. Determination of the renal clearances of iothalamate-^{125}I and iodopyracet-^{131}I is an accurate and time-saving technique for the measurement of GFR and ERPF. (BBB)

25744 PATHWAYS OF GLUCOSE METABOLISM IN IRRADIATED AND NON-IRRADIATED TISSUE CULTURE ASCITES CELLS. Kohen, Elli; Kohen, Cahide; Thorell, B. (Karolinska Inst., Stockholm). Exp. Cell Res., 49: 169-80(Jan. 1968).

The microfluorimetric-microelectrophoretic technique which allows the fluorescence assay of reduced pyridine nucleotides in localized cellular portions during microelectrophoretic treatment with metabolites, was used for comparative experiments between x irradiated ascites giant tissue culture cells (EL2G) and their non-irradiated counterparts (EL2SG). There were preliminary indications that the extramitochondrial fluorescence responses to glucose or microelectrophoretic mixtures containing glucose-6-phosphate, fructose-1,6-diphosphate, and 6-phosphogluconate are more intense in the irradiated cell, while there is a higher response to uridine-diphosphoglucose in the non-irradiated cell. The responses to a multipotential component such as fructose-6-phosphate are similar in both cell types. The non-irradiated cells are more sensitive to Rotenone (an inhibitor of DPNH-cytochrome b reductase) which enhances the extramitochondrial fluorescence response to substrates of glucose catabolism. The higher glycolytic activity and lower sensitivity to Rotenone seen in the irradiated cell may be due to radiation damage of their respiratory membrane structures, e.g., the mitochondrial lipoprotein membranes. (auth)

25745 MOLECULAR WEIGHT ESTIMATION OF MEMBRANE BOUND ATPase BY IN VACUO RADIATION INACTIVATION. Kepner, Gordon R.; Macey, Robert I. (Univ. of California, Berkeley). Contract AT(11-1)-34. Biochem. Biophys. Res. Commun., 30: 582-7(Mar. 12, 1968).

Radiation inactivation (7.5 MeV electrons) was utilized to estimate the equivalent molecular weight of sodium-potassium stimulated adenosinetriphosphatase (Na-K-ATPase) in erythrocyte ghosts and in NaI treated brain microsomes. Since oxygen is known to influence the radiation sensitivity of enzymes, radiation target theory is most applicable to dried samples irradiated in vacuo. Accordingly, the radiation sensitivity of membrane bound ATPase was restudied carrying out all irradiations in vacuo. The presence of air had a marked effect on the ATPase sensitivity and suggests that previous estimates of its molecular weight based on air irradiation must be reevaluated. Current data suggest a molecular weight of the order of 250,000 for the Na-K ATPase of human erythrocytes and guinea pig kidney cortex microsomes. (auth)

25746 IMMUNE STATUS OF THE PRIMARY HOST TOWARD ITS OWN METHYLCHOLANTHRENE-INDUCED SARCOMAS. Stjernsward, Jan (Karolinska Inst., Stockholm). J. Nat. Cancer Inst., 40: 13-22(Jan. 1968).

The immune status of 55 mice toward their own sarcomas induced by 3-methylcholanthrene (MCA) was tested by immediate transplantation of small graded doses of tumor cells after the primary tumor was removed by radical surgery. An increased susceptibility was found in comparison with that of untreated syngeneic controls whose right hind legs were amputated and, to a lesser extent, with that of MCA-exposed syngeneic hosts. Mice preirradiated with 350 to 400 R x radiation before tumor transplantation supported the growth of the isografts slightly better than MCA-exposed hosts. Pretreatment of syngeneic hosts with mycobacterium tuberculosis 6 to 72 hours before tumor transplantation also facilitated takes. First-generation isografts of another MCA-induced primary tumor were not accepted as well by the host following excision of the primary tumor, as were its own autografts. Thus the increased susceptibility to the autochthonous tumor possibly reflects partial tolerance in the primary host to its own MCA-induced sarcoma. (auth)

25747 MECHANISMS OF IMMUNITY TO SARCOMA I ALLOGRAFTS IN THE C57BL/Ks MOUSE. I. PASSIVE TRANSFER STUDIES WITH IMMUNE PERITONEAL MACROPHAGES IN X-IRRADIATED HOSTS. Tsoi, Mang-so; Weiser, Russell S. (Univ. of Washington, Seattle). J. Nat. Cancer Inst., 40: 23-30(Jan. 1968).

Passive transfer of immunity to sarcoma I (SaI) allografts was demonstrated by sublethal inoculation of x-irradiated C57BL/Ks mice subcutaneously with mixtures of immune peritoneal macrophages and SaI cells. The degree of suppression of tumor growth was directly related to the number of immune macrophages added to the tumor inoculum. When inocula containing tumor cells and macrophages in ratios of 5:1, 2:1, and 1:1 were used, tumor growth was suppressed significantly. Tumor growth was unaffected when cells in the ratio of 10:1 were used. When immune macrophages were injected intraperitoneally and tumor cells were inoculated subcutaneously, no inhibition of tumor growth was noted. The growth of the ascites form of SaI was studied by mixing the inoculum of tumor cells with immune macrophages in ratios of 10:1, 4:1, 2:1, and 1:1. Tumor suppression was obtained only with inocula in which the tumor cells and immune macrophages were in ratios of 2:1 and 1:1. The results indicate that macrophages contribute significantly to the rejection of SaI allografts in the C57BL/Ks mouse. Moreover, they support the concept that the tumor-suppressive action of macrophages demands contact with the tumor cells. (auth)

25748 MECHANISMS OF IMMUNITY TO SARCOMA I ALLOGRAFTS IN THE C57BL/Ks MOUSE. II. PASSIVE TRANSFER STUDIES WITH IMMUNE SERUM IN X-IRRADIATED HOSTS. Tsoi, Mang-so; Weiser, Russell S. (Univ. of Washington, Seattle). J. Nat. Cancer Inst., 40: 31-6(Jan. 1968).

When a dose of 0.2 ml of immune serum was mixed with an inoculum of 10^6 sarcoma I (SaI) cells and administered subcutaneously to x-irradiated C57BL/Ks mice, a small but significant inhibitory effect on the initial growth of the resulting solid tumor was observed. However, after two weeks, enhanced growth of the tumor became evident. When the tumor and immune serum were administered intraperitoneally, the ascites form of SaI was inhibited, and no period of enhanced tumor growth could be detected, even at later intervals, because the control animals showed progressive growth of tumor. A dose of immune serum as low as 0.01 ml was sufficient to cause significant prolongation of survival time in the mice with intraperitoneally inoculated tumor. This protective effect of immune serum became progressively more pronounced with increasing doses of immune serum, to the level of 0.05 ml. Higher doses afforded no additional protection. (auth)

25749 MECHANISMS OF IMMUNITY TO SARCOMA I ALLOGRAFTS IN THE C57BL/Ks MOUSE. III. THE ADDITIVE AND SYNERGISTIC ACTIONS OF MACROPHAGES AND IMMUNE SERUM. Tsoi, Mang-so; Weiser, Russell S. (Univ. of Washington, Seattle). J. Nat. Cancer Inst., 40: 37-42(Jan. 1968).

X-irradiated C57BL/Ks mice were used for studies on the combined action of immune serum and macrophages in the passive transfer of immunity to sarcoma I (SaI) allografts. Whereas immune macrophages mixed with tumor inocula strongly suppressed solid tumor growth, immune serum mixed with tumor inocula produced only slight inhibition of tumor growth, confined to the early period after inoculation. The most marked inhibition of growth of solid tumor resulted when both immune macrophages and immune serum were mixed with the tumor inoculum. This effect was probably additive. The combination of nonimmune macrophages and immune serum acted synergistically to inhibit solid tumor growth, even when the immune serum was administered at a site distant from the inoculum. The combination of immune serum and immune macrophages acted additively and possibly synergistically to suppress ascites tumor growth. (auth)

25750 ORGAN ANTIBODIES AFTER LOCAL IRRADIATION. Jonsson, Jonas; Einhorn, Nina; Fagraeus, Astrid; Einhorn, Jerzy (Karolinska Institutet, Stockholm). Radiology, 90: 536-40(Mar. 1968).

In 129 patients with hyperthyroidism and in 47 euthyroid subjects serologic reactions were studied before and after intensive local irradiation with ^{131}I. Antibodies to thyroglobulin, thyroid cytoplasm, parietal cells, cell nuclei, and bovine and human gamma globulin were examined. In addition, 86 patients receiving intensive local radium therapy for carcinoma of the corpus or cervix uteri were examined in the same way. After irradiation of the thyroid gland there was an increase in thyroid antibodies but there was none in the other antibodies studied. No such increase in thyroid antibodies was observed after intensive local irradiation of other tissues (uterus and vagina) or, according to earlier results, after a reduction in thyroid volume or a lowering of thyroid function produced by surgical treatment. The increase in thyroid antibodies is not a manifestation of a general stimulation of the antibody-producing apparatus but seems to be an expression of an autoimmune reaction specifically directed against the irradiated thyroid tissue. (auth)

25751 LUNG CLEARANCE OF MONO- AND DI-DISPERSE AEROSOLS DETERMINED BY PROFILE SCANNING AND WHOLE-BODY COUNTING: A STUDY ON NORMAL AND SO_2-EXPOSED RABBITS. Holma, Bo (Karolinska Inst., Stockholm). Acta Med. Scan., Suppl. 473, 102p(1967).

A profile scanning method employing radioisotopes was devised and used to study lung clearance in rabbits. The validity of the method was evaluated by studies on rabbit phantoms with known distributions of radioactivity, as well as on living animals exposed to radioactive aerosols and thereafter sacrificed. The radioactivity in the isolated lung was measured by the conventional scaler technique. These comparisons demonstrated that profile scanning was well suited to the investigation of lung clearance during the first hours after exposure and up to one or two weeks thereafter. The profile scanning method was superior to methods previously used with stationary detector systems. In producing monodisperse ^{198}Au and ^{46}Sc particles of n-octadecanol and polystyrene, suitable for lung clearance studies, the condensation and spinning disc methods were used. The profile scanning technique for studying lung clearance was used with 3- and 6-μm polystyrene particles. For the lung clearance of the 3-μm particles tagged with ^{46}Sc it was possible, due to the longer half-life of ^{46}Sc, to continue the study for several months after exposure by performing whole-body counting. Some rabbits were exposed to SO_2 after the initial measurement while others were used as controls. The results of the pre-exposure values showed a half-life for the smaller particles of 2.3 and 209 hr for the first and second phases, respectively. The corresponding figures for the larger particles were 1.8 and 161 hr. A greater percentage of larger particles compared to small particles was cleared during the first clearance phase. No effect of SO_2 (10 ppM, 16 hr/day during 10 weeks) on lung clearance of a di-disperse aerosol (6- and 3-μm particles) was seen on the first phase during five weeks of exposure. An accelerating effect was observed during the first six weeks of the slower phase of the 3-μm particles and the 6 μm particles. Prolonged exposure (more than six weeks) diminished this effect on the slower phase. Differences in retention between the different particle sizes were studied by the retentions of the monodisperse 3- and 6-μm particle sizes that were compared at different levels of the lung and at different times after exposure by a new technique that was based on scaler measurements on selected specimens cut from formalin-fixed and air-dried lung preparations. The findings indicated that the initial retentions of both particle sizes in the alveoli remained essentially unchanged during the first 72 hr. (BBB)

25752 THE INCORPORATION OF ORALLY ADMINISTERED RADIOIODINE INTO HENS' EGGS AND FOLLICLES. Thorell, Carl Bertil (Royal Veterinary Coll., Stockholm). Acta Vet. Scand., 5: 224-37(1964).

Doses of 10 to 50 μCi of carrier-free ^{131}I were fed to eight-month to two-yr-old White Leghorn hens. With single doses the ^{131}I content of the shell, including the shell membranes, reached a maximum of 0.017% of the given amount per g of shell in eggs laid within one day after administration. The albumen reached a maximal concentration of 0.01%/g in eggs laid about one day after administration. Subsequent reduction in ^{131}I concentration both in the shell and egg white from eggs laid later showed a rapid course. In the yolk, radioiodine began to appear in eggs laid about one day after administration, with a maximal concentration of 2.78% of the given amount per yolk in eggs laid about five days later. The subsequent reduction in ^{131}I concentration could be followed in the yolk from eggs laid up to and including the ninth day after administration; then the concentration was about $1/_{50}$ of the maximal concentration. With continuous administration of ^{131}I once daily for 16 days, the concentration in the shell and egg white was the same as corresponding maximal concentration with single dose administration as long as the daily supply continued. Following cessation of administration, the concentration decreased in the shell and white with a course similar to that obtained in single doses. In the yolk, the concentration increased in eggs laid up to and including the ninth day after commencement of the continuous dosing; thereafter, the equilibrium remained as long as ^{131}I administration continued. About 13% of the daily given dose of ^{131}I was recovered per yolk. The follicular uptake of ^{131}I after single dose administration was rapid, with the greatest uptake by the follicle in the most rapid phase of growth at the time of administration. Autoradiography of the follicles and eggs following single dose administration of ^{131}I showed most of the radioiodine in the growth zone corresponding to follicle development during the first day after administration. (BBB)

25753 BEHAVIOR OF SOME ENZYME ACTIVITIES IN SERUM, LIVER, AND SPLEEN OF IRRADIATED RATS. Zanolla, W. R. (Univ., Pavia, Italy). Radiobiol. Radioter. Fis. Med., 22: 205-20(July-Aug. 1967). (In Italian).

Qualitative and quantitative data are presented on the chemical behavior of four enzymes: leucine aminopeptidase (LAP), lactate dehydrogenase (LDH), γ-glutamyltranspeptidase (γ-GT), and alkaline phosphatase in blood serum, liver, and spleen of x-irradiated rats. The modifications of the total activity and of the electrophoretic patters suggest a three-phase action mechanism. During the first phase a breaking down of enzymatic proteins took place. Enzyme inactivation in the tissues characterized the second phase. About the fourth day cellular regeneration began. This was confirmed by enhanced mitochondrial and microsomal activity. The enzymatic electrophoretic picture suggested that in the last phase the liver cell might manufacture some different enzymatic proteins (enzyme variants). (auth)

25754 CONCENTRATION OF ^{137}Cs, ^{65}Zn, AND ^{85}Sr BY FRESH-WATER ALGAE. Harvey, R. S. (Savannah River Lab., Aiken, S. C.); Patrick, Ruth. Biotechnol. Bioeng., 9: 449-56(Oct. 1967).

Studies were made to determine the patterns and levels of radionuclide concentration and retention by diatoms and algae typically found in the soft waters of the reactor effluent streams at the Savannah River Plant. Differences in the concentration and retention of ^{137}Cs by unicellular diatoms, filamentous green algae, and filamentous blue-green algae were demonstrated under both batch and continuous-flow culture conditions. The ^{137}Cs concentration factors were generally higher by a factor of two in batch tests than in continuous flow tests. In retention studies, ^{137}Cs was desorbed more rapidly from algae under continuous-flow conditions. Studies with blue-green algae indicated that ^{137}Cs concentrations in the various species were more closely related to the surface-to-volume ratios of algal cells than to the systematic relations of the three species. Continuous-flow studies indicated no differences among three species of filamentous green algae in the concentration of ^{137}Cs, ^{65}Zn, and ^{85}Sr. However, the average concentration factors of the radionuclides were considerably different: 3800 for ^{65}Zn, 460 for ^{137}Cs, and 230 for ^{85}Sr. These radionuclides were rapidly desorbed following the transfer of algae to nonradioactive media, the desorption rate being inversely related to the concentration rate. (BBB)

25755 EFFECTS OF FAST ELECTRONS ON MATTER. Harder, Dietrich (Univ., Wuerzburg, Ger.). Ber. Phys.-Med. Ges. Wuerzburg, 71: 124-7(1962-4). (In German).

For the biological effects of irradiation, the reaction produced per unit of energy dose generally depended on the linear energy transfer (LET). In effects with small energy requirements per reactant unit, such as inactivation of virus or enzyme molecules, the yield usually decreased with increasing LET, because there was a saturation effect. In effects that had large energy requirements, such as production of chromosome breaks, the yield was maximal only at high values of LET, representing a "concentration" effect. In irradiation therapy with fast electrons where destruction of chromosomes or cell growth inhibition increased with increasing LET, the slow and medium energy secondary electrons had considerably more effectiveness than the primary fast electrons. Thus, for fast electrons of various energies, the radiation with the greatest number of slow and medium energy secondary electrons delivered the greatest yield per dose unit. Since the average energy of the electron beam decreased with increasing tissue thickness, the yields of cell reactions would vary with their location in tissue. (BBB)

25756 A GENERAL APPROACH FOR COMPUTATION AND INTERPRETATION OF DILUTION CURVES. Melbin, Julius (Univ. of Pennsylvania, Philadelphia). IEEE (Inst. Elec. Electron. Eng.) Trans. Bio-Med. Eng., BME-14: 244-51(Oct. 1967).

An appraisal is made of computerized methods used in the evaluation of radioisotope and dye dilution curves. Based on requirements of experimental and clinical studies, a general on-line real-time approach was proposed that increased information retrieval from standard curves. A simple, hybrid scheme tested for exponential or other declines is desired. The point for curve extrapolation was determined by the test that also controlled the character of the extrapolated curve. Information obtained from the test itself could define characteristics of the decline and thereby yield insight into the character of the system itself. As it tested for the desired reference regardless of variations in tracer curves, the technique offered both precision and accuracy. It was adaptive, in that individual needs could be satisfied by adding tests, and/or monitoring checks, and/or adjusting coefficients. Approximations to required extrapolations could be made at the discretion of the user. A particular configuration was presented that tested for exponential decline. If decline was not exponential, as had been experienced in the absence of recirculation, the procedure computed the actual curve without substitution. The scheme and appropriate modes and logic were presented, as well as recordings of illustrative curves. (BBB)

25757 VARIABILITY IN FUSARIUM SECTION SPOROTRICHIELLA INDUCED BY ULTRAVIOLET RAYS. Kvashnina, E. S. (All-Union Scientific-Research Inst. of Experimental Veterinary Science, USSR). Microbiology (USSR) (Engl. Transl.), 36: 381-6(May-June 1967).

The effect of uv (2537 Å) irradiation on toxin production and cultural and morphologic properties of F. sporotrichioides var. minus 5328 and F. poae f. 1.5253 and f. 1.5252, the pathogens of fusariotoxicosis in livestock, was studied. The sensitivity of conidia of the three Fusarium strains studied was different. Conidia of a highly toxic strain of F. sporotrichioides var. minus were more resistant than conidia of a toxic strain of F. poae f. 1. Conidia of a slightly toxic strain of F. poae f. 1 were still less resistant. The uv response in F. sporotrichioides var. minus, as well as the variants with reduced toxicity, differed from the parent strain. Stability in respect of the toxin production character was noted in morphologically altered uv varients. As a result of uv irradiation at doses of 6900 and 10,350 erg/mm^2, variants of F. sporotrichioides var. minus arose which produced pseudopionnotes and sporodochia in greater numbers than the parent culture. In the two strains of F. poae f.1, uv treatment induced a slight shift in variability tending toward a decrease in toxin production, and slight, unstable morphological variability. (BBB)

25758 RADIOLUMINOUS PAINTS AS ACTIVATOR OF PHOTORECEPTOR SYSTEMS STUDIED WITH SWALLOW-TAIL BUTTERFLY AND QUAIL. Kato, Masaru; Kato, Yoshiomi; Oishi, Tadashi (Kyoto Univ.). Proc. Jap. Acad., 43: 220-3(Mar. 1967).

The effect of radioactive paint on the photoperiodical mechanism in the swallow-tail butterfly Papilio xuthus and the Japanese quail Coturnix coturnix japonica, using two commercial radioluminous paints, was investigated. The part of the skin of the animals presumed to be related to their photoreceptor mechanism(s) was painted with LC-GIH for P. xuthus, and both LC-GIH and LC-RIA for C. coturnix. Both paints emitted a characteristic light by being activated with β irradiation from tritium contained in the paint binder. The LC-RIA paint that was composed of particular inorganic pigment and tritium emitted an orange-red self-luminous light (maximum at 600 mμ); LC-GIH produced a green-yellow (maximum at 520 mμ) light. The brightness in both cases was 98 μL and 0.3 in cd/m^2, and lasted for 180 days in air at room temperature and atmospheric pressure until it decayed to 80% of the peak. The LC-GIH green-yellow light apparently penetrated through the insect's chitin covering, and was absorbed by the photoreceptor center, presumably in the brain. The proportion of caterpillars that subsequently became nondiapausing pupae was strikingly higher in the treated group than in either of the control groups. The LC-RIA paint was applied on a small surface area of the skin of the quail above the pineal gland. The average testes weight of birds treated with the LC-RIA paint was similar to that in the control group that had been maintained under a continuous light, while the average testes weight in unpainted controls kept in the dark showed markedly lower values. The results indicated that this was a useful method for detecting systems of photoperiodic reception in animals. (BBB)

25759 AN UNUSUAL REACTION OF HYDROGEN SULPHIDE AND HYDROGEN IODIDE WITH FREE RADICALS IN IRRADIATED DRY DEOXYRIBONUCLEIC ACID. Ormerod, M. G.; Riesz, P. (Yale Univ., New Haven, Conn. National Cancer Inst., Bethesda, Md.). Biochim. Biophys. Acta, 149: 451-8(Dec. 19, 1967).

Samples of dry DNA were irradiated with γ rays. After irradiation, the DNA was reacted with either tritium-labeled H_2S or HI in an attempt to label the sites of the stable free radicals. The DNA was then degraded and the products separated chromatographically. It was found that there was a radiation induced reaction between the gases used and the DNA, but that the yield of tritium-labeled products was greatly in excess of the initial concentration of free radicals. This is in contrast to the result previously obtained from similar experiments with proteins. It is suggested that this difference is a chain reaction caused by the reaction of $HS\cdot$ or $I\cdot$ with the DNA. (auth)

25760 ASSOCIATION OF NEUTRAL DEOXYRIBONUCLEASE WITH CHROMATIN ISOLATED FROM MAMMALIAN CELLS. Swingle, Karl F.; Cole, Leonard J.; Bailey, J. Stanley (Naval Radiological Defense Lab., San Francisco). Biochim. Biophys. Acta, 149: 467-75(Dec. 19, 1967).

Nuclei prepared from spleen cells by a variety of published procedures retained a deoxyribonuclease that caused a partial degradation of the nuclear DNA when the nuclei were incubated in the presence of divalent cations. Well-washed chromatin from disrupted nuclei of either spleen or liver retained the deoxyribonuclease, but the soluble nucleoprotein was free of it. The latter preparation was also resistant to attack by added deoxyribonuclease I. The nuclear deoxyribonuclease was shown to be of the deoxyribonuclease I type, that produces 3′-hydroxyl-terminated fragments of DNA. X irradiation of washed nuclei in vitro did not alter their susceptibility to degradation by their endogenous deoxyribonuclease. Chromatin from free thymocytes did not contain endogenous deoxyribonuclease I activity. (auth)

25761 APPARATUS FOR CONTINUOUS MONITORING OF $^{14}CO_2$ FROM LARGE ANIMALS. Bruce, R. B.; Newman, J. H.; Pinchbeck, F. (A. H. Robins Co., Inc. Richmond). Int. J. Appl. Radiat. Isotop., 19: 391-5(Apr. 1968).

A metabolism chamber was designed for large animals to permit continuous monitoring of expired carbon-14 dioxide for 24 hr or longer and to separate and retain excretion products. This apparatus allows individual sampling of expiration for quantitative analyses without interruption of the study. (auth)

25762 COMPARATIVE STUDY ON RETENTION AND DISTRIBUTION OF ^{137}Cs AND ^{86}Rb IN RATS. Inaba, Jiro (National Inst. of Radiological Sciences, Chiba, Japan); Matsusaka, Naonori; Takata, Naoko; Iinuma, Takeshi A.; Aizawa, Katsuo; Ichikawa, Ryushi. Radioisotopes (Tokyo), 17: 151-5(Apr. 1968).

The metabolism of ^{86}Rb and ^{137}Cs, whole-body retention, and tissue distribution after single oral administration to rats were investigated by means of a double tracer method. The result showed marked differences of metabolic behavior between these two radionuclides. Whole-body retention of ^{86}Rb could be expressed by a single component exponential function of time, while that of ^{137}Cs by two components. The time required for attaining the equilibrium distribution pattern was three days after administration for ^{86}Rb, while six days for ^{137}Cs. At the equilibrium in distribution, ^{137}Cs was concentrated specifically in muscle tissue, while ^{86}Rb concentration in liver and spleen was much higher than ^{137}Cs in these tissues. The distribution study gave a reasonable interpretation for the results of a previous profile-scanning study on a human subject. (auth)

25763 CONTENT OF ASCORBIC ACID IN RADIOSENSITIVE TISSUES DEPENDING ON THE DOSE OF IONIZING RADIATION (GAMMA-RAYS). Lavrov, B. A.; Filippov, Yu. M.; Yanovskaya, B. I. (Research Inst. of Preserved Food, Moscow). Byull. Eksp. Biol. Med., 64: No. 12, 46-50(Dec. 1967). (In Russian).

The effects of different doses of γ-radiation delivered in single whole-body doses to white rats were studied. The radiation effect was assessed during one month by the weight of the spleen and testicles, and, the content of ascorbic acid in the tissues of the spleen, testicles, and bone marrow. Disturbances caused by doses of 600, 500, and 250 R were uniform in type, but the degree of disturbance depended on the dose. A decrease of biosynthesis of ascorbic acid was observed after large doses in the first days after irradiation, and small doses during the same period produced an increase of ascorbic acid concentration in the radiosensitive tissues, i.e. biosynthesis of ascorbic acid increased. Analogy was found to exist in the biosynthesis of ascorbic acid under the influence of different doses of ionizing radiation and that produced by toxic agents. (auth)

25764 ACTION OF FREE RADICALS ON SOLUTIONS OF SUPERPOLYMER DEOXYRIBONUCLEIC ACID. Nikolova, E. R.; Struchkov, V. A.; Kuzin, A. M. Radiobiologiya, 7: 477-8(1967). (In Russian).

The effect of free radicals in Fenton's reagent (H_2O_2 + $FeSO_4$) on superpolymer DNA isolated from the rat's thymus was studied by determining changes in the viscosity of DNA. The superpolymer DNA in dilute solutions (0.002%) was highly sensitive to the action of the free radicals; the decrease in the reduced viscosity within 5 min after addition of Fenton's reagent in a concentration of 10^{-6} M H_2O_2 + 5×10^{-6} M $FeSO_4$ amounted to 25%. (JPRS)

25765 EFFECT OF X-RAYS ON THE SYNTHESIS OF SPECIFIC TISSUE PROTEINS AND PROTEIN SECRETIONS. Ivanov, I. I.; Rudakov, V. V. Radiobiologiya, 7: 319-22(1967). (In Russian).

Isolated lactic glands of goats that were perfused with an oxygenated suspension of erythrocytes from the same animal were irradiated with x rays. The erythrocyte suspension used did not contain either free amino acids or blood plasma proteins. The capacity of an isolated and perfused lactic gland to secrete milk and synthesize milk proteins was not altered on x-irradiation at a dose of 1000 R as compared with a nonirradiated control gland. The capacity to synthesize milk proteins was also preserved on irradiation of an isolated gland at 5000 R. The milk proteins were formed from reserve tissue proteins of the gland. (JPRS)

25766 QUANTITATIVE AND QUALITATIVE ALTERATIONS OF DNA IN RADIOSENSITIVE ORGANS OF IRRADIATED MICE. III. CATABOLIZING EFFECT OF IONIZING RADIATIONS ON DNA. Voiculet, N. Oncol. Radiol., 6: 13-16(1967). (In Rumanian).

Tritium-labeled thymidine was injected into 22 mice ten min before irradiation in order to study the catabolizing effects of ionizing radiation on DNA. Analysis of the polymerized fraction extracted from the intestine and bone marrow at one, six, and 24 hrs after irradiation gave the following results: the DNA/RNA ratio remained constant; the specific activity and amount of DNA were comparatively low at six and 24 hrs. Irradiation delivered shortly after the administration of the precursor made it possible to study cellular turnover in the synthesis phase. The degree of radioresistance of the cells in the synthesis phase was similar in the intestine and bone marrow. (TSS)

25767 RADIATION DAMAGE TO CRYSTALLINE RIBONUCLEASE: IMPORTANCE OF FREE RADICALS IN THE FORMATION OF DENATURED AND AGGREGATED PRODUCTS. Haskill, J. S.; Hunt, J. W. (Univ. of Toronto. Ontario Cancer Inst., Toronto). Radiat. Res., 606-24(1967).

The production of denatured and aggregated products from crystalline RNase was studied following irradiation by ^{60}Co γ-rays in vacuo, in oxygen and H_2S, and in the presence of the paramagnetic ion, Cu^{++}. The yields of these products were determined by gel filtration of the irradiated enzyme on G-75 Sephadex. The results showed that aggregation occurred through relatively slow free radical reactions which were eliminated or altered by free radical scavengers such as O_2 and H_2S. Conversely, the yield of denatured products was enhanced from 1.2/100 eV (in vacuo) to 2.4/100 eV by these gases. The yield of both aggregated and denatured molecules decreased in the presence of Cu^{++} ions, suggesting that these ions reduce the effective radiation dose. Detailed reaction schemes were proposed to account for the rates of formation of the products, and the yields deduced from these schemes were in reasonable agreement with the yields for inactivation of the enzyme under the same conditions. Two peaks, which eluted in the region of the aggregates, were identified as dimers and trimers of RNase. The trimer was observed even at low radiation doses. (auth)

25768 STUDY OF DEOXYRIBONUCLEOPROTEIN STRUCTURE OF THE SPLEEN AND LUNGS IN MICE IN THE EARLY PERIOD FOLLOWING IRRADIATION AND ADMINISTRATION OF URETHANE. Grigorovich, N. A.; Ivanov, M. T. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Byull. Eksp. Biol. Med., 64: No. 12, 41-4(Dec. 1967). (In Russian).

The structure of deoxyribonucleoprotein from the spleen and lungs of mice after fractional γ-irradiation and administration of urethane was studied. Immediately after irradiation and 24 hours later destruction of the tertiary and quaternary structure of DNP of the hemopoetic tissue of irradiated animals was noted. Changes indicated a weakened interaction between DNA and protein in the nucleoprotein molecule, and decreased forces of intermolecular interaction. Only 24 hours after administration of urethane there was a slight change in the tertiary structure of DNP, that reflected an increased interaction between DNA and histone in the nucleoprotein of the pulmonary tissue. (auth)

25769 TIME COURSE OF THE DISTRIBUTION OF IN VIVO ADMINISTERED $^{89}Sr^{++}$ IN RAT LIVER SUBCELLULAR FRACTIONS. Carafoli, E.; Tiozzo, R. (Univ. of Modena, Italy). Experientia, 23: 1017-18(Dec. 15, 1967).

The ^{89}Sr content of rat liver was determined after intraperitoneal injection. The radioactivity in the homogenate increased in two to three min to a plateau that was maintained for at least 60 min. Immediately after the injection the largest part of the ^{89}Sr was found in the mitochondria; during the first three min the amount decreased rapidly, then more slowly. A minor part of the ^{89}Sr was found in the microsomes immediately after injection; the amount doubled in three min and then increased more slowly. Small amounts of ^{89}Sr were found in the cell sap immediately after injection; this amount increased quickly to account for 15 to 20% of the total radiostrontium of the cell after two to three min. Results are shown by means of graphs. The results indicate that ^{89}Sr is transferred from one organelle to another in the liver cell. Deposition of radiostrontium seems to involve both mitochondria and the endoplasmic reticulum. (H.L.W.)

25770 EFFECT OF CARRIER CALCIUM LEVEL ON THE COMPARATIVE METABOLISM OF ^{45}Ca AND ^{89}Sr IN THE RAT. Menczel, J. (Hebrew Univ., Jerusalem); Pakis, G. A.; Likins, R. C. Israel J. Med. Sci., 3: 697-701(Sept.-Oct. 1967).

Data relative to the effect of dietary Ca on the absorption of Sr when given as a single oral dose are reported, the results indicating that the Ca intake determines Sr retention even following acute exposure to Sr. Sprague-Dawley rats weighing 90 to 100 g were fasted for 12 hr, then given intragastrically 2.0 ml of a water-soluble chemically defined diet containing either 0.1% or 0.5% Ca, as mono-Ca fructose-1,6-diphosphate, plus high specific activity ^{45}Ca and carrier-free ^{89}Sr. Radioassays made 1, 2, and 4 hr later showed that the absorption of ^{45}Ca from the gastrointestinal tract and the incorporation into bone was larger than that of ^{89}Sr under all circumstances. The low-Ca diet resulted in a 2-fold increase in the absorption of both isotopes. The plasma concentration and the retention of ^{45}Ca and ^{89}Sr by bone were higher in the animals receiving the low-Ca diet. (BBB)

25771 ACTION OF HOMOLOGOUS TISSUE EXTRACTS ON PROTEIN SYNTHESIS IN RATS. AN ELECTROPHORETIC STUDY. Correni, E.; Benes, S.; Mihaescu-Nigrim, M. Radiobiol. Biol. Mol., 57-62(1967). (In Rumanian).

Two groups of rats were immunized with a mixture of liver and spleen water-soluble extracts. Serum collected from normal and from 1,000 R irradiated rats, 18 days after the last injection, was examined electrophoretically. A decrease in the absolute values of albumin concentration and an increase in the amount of beta and gamma globulins were found in immune sera of both groups. The total proteins rose only in the serum of irradiated rats. Between the two immune sera, significant differences in albumin and in gamma globulins were recorded. The gamma globulin increase in the latter as against the normal immune serum was not statistically significant. The interpretation of the recorded changes and the toxic and antigenic action of inoculated products, as well as the consequence of immunization-induced hepatic lesions, are discussed. (auth) (Romanian Sci. Abstr.)

25772 SHIFT OF THE RADIOACTIVE EQUILIBRIUM BETWEEN ^{90}Sr-^{90}Y IN THE ORGANISM OF RATS AFTER ORAL ADMINISTRATION. Krawielitzki, K. (Oskar-Kellner-Institut fuer Tierernaehrung, Rostock, Ger.). Isotopenpraxis, 3: 383-5(Sept. 1967). (In German).

The magnitude of the displacement of the $^{90}Sr:^{90}Y$ ratio by intestinal resorption and by the chemical and physical chemical processes in the individual organisms was investigated in the rat after oral administration. The equilibrium displacement observed in the blood, muscle, skeleton, skin, liver, kidney, and feces three days after oral administration is tabulated, and the discrimination factors are given. A sharp enrichment of the ^{90}Y was observed in the kidney and liver. (J.S.R.)

25773 ^{47}Sc INERT MARKER TECHNIQUE AS A TEST OF CALCIUM ABSORPTION. Ogg, G. S.; Pearson, J. D.; Veall, N. (St. Philip's Hosptial, London. Guy's Hospital Medical School, London). Strahlentherapie, Sonderbaende, 65: 415-19(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Investigations such as calcium absorption tests require the col-

lection of feces from patients. Measurements can be valueless if fecal specimens are lost. A technique for measuring net ^{47}Ca absorption by exploiting the fact that ^{47}Ca decays to radioactive ^{47}Sc is described. Previous work showed that ^{47}Sc is not absorbed from the gut and therefore this isotope serves as an inert marker. There was no systematic difference from values obtained by the cumulative excretion technique in 38 patients, but the results obtained using small fecal samples were variable owing to inhomogeneous distribution of the two isotopes in the gut. This difficulty might be overcome by sampling from previously homogenized pooled specimens. (auth)

25774 MEASUREMENT OF RAPIDLY EXCHANGEABLE COMPARTMENTS BY RATE OF EXCHANGE AND TRANSFER OF MAGNESIUM BY MEANS OF ^{28}Mg IN THE NORMAL AND PATHOLOGIC ADULT. PRELIMINARY RESULTS. Raynaud, C.; Kellershohn, C. (CEA, Orsay, France). Strahlentherapie, Sonderbaende, 65: 430-9(1967). (In French).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Specific radioactivity was determined in plasma, urine, and feces four to six days after injection of $^{28}MgCl_2$. Eight normal and 22 pathologic subjects were examined, of which 17 of the patients suffered from normocalcemic tetany. To explain the kinetics of the exchangeable magnesium, a three compartment model was used, presenting urinary and fecal loss as well as a considerable exchange with a magnesium pool of low turnover. Significant differences were observed between normal subjects and patients as far as these parameters are concerned. There was, however, no correlation between experimental results and clinical status. (auth)

25775 BRONCHOSPIROMETRY OF ^{133}Xe RADIOSPIROMETRY IN THE STUDY OF REGIONAL LUNG FUNCTION. Arborelius, M. Jr.; Fafgelj, A.; Lassen, N.; Lindell, S. E.; Miorner, G.; Svanberg, L. (Allmanna Sjukhuset, Malmo, Sweden). Strahlentherapie, Sonderbaende, 65: 440-5(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Xenon-133 radiospirometry and bronchospirometry were compared as regards the measurement of the function of each lung separately. In 21 patients who were investigated before lung surgery excellent agreement was found between the radiospirometric and bromchospirometric measurement of relative perfusion. Various ways of measuring relative ventilation during radiospirometry were tested against the relative ventilation as measured with bronchospirometry. The best agreement was found when the radiospirometric ventilation was measured as the level of radioactivity in the lung after three normal breaths of ^{133}Xe from a rebreathing system. It was concluded that radiospirometry can now replace bronchospirometry for most practical purposes. (auth)

25776 MODEL INVESTIGATION OF ERROR ESTIMATION IN "RADIOCARDIOGRAPHIC FUNCTION ANALYSIS" BY USE OF ^{51}Cr. Kleine, N.; Hoffmann, G. (Univ. Freiburg i.B.). Strahlentherapie, Sonderbaende, 65: 446-50(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

A heart phantom containing ^{51}Cr-labeled water was used in an evaluation of sources of error in radioisotope-cardiography. Results showed that changes of lung background-radioactivity due to changes of the ventricle volume had little or no influence on the results. Counting differences due to differences in systolic and diastolic volume depend on size of the ventricles and no direct correlation could be found between these counting differences and stroke volume. It is much simpler to take the percentage error of these counting differences originating from changes in size of the ventricles into account. Deviations of the registered counting difference between systole and diastole amount to 2% if the ventricle volume is larger than 400 ml and if the change in ventricle volume is ±10%. It is not necessary to apply corrections if only relative values for the function of the heart are of interest. (auth)

25777 IMMUNOLOGIC PROPERTIES OF RADIOACTIVE IODINATED INSULIN. Ooms, H. A.; Arquilla, E. R. (Univ., Brussels. Univ. of California, Los Angeles). Strahlentherapie, Sonderbaende, 65: 316-24(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Investigations were made to determine whether or not radioactive iodinated (^{125}I and ^{131}I) insulin behaves similarly to crystalline insulin in its ability to combine with insulin-antibodies. Experiments were designed to test if guinea pig antibodies directed against crystalline insulin combined to the same degree with both unlabeled and labeled insulin. The results indicate that, when in competition with unlabeled insulin, iodinated insulin is preferentially displaced from the antibody complex. This demonstrates a significant impairment of the antigenic properties of radioactive insulin. Furthermore, preliminary experiments suggest that iodinated insulin reacts only with part of the antibody-sites available. This has some implication in the interpretation of the radioimminoassays. (auth)

25778 RADIATION RESEARCH. Proceedings of the Third International Congress held at Cortina d'Ampezzo, Italy, June–July, 1966. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967. 939p. (CONF-660614).

Twelve chapters and a discussion of the developments in radiation research and radiation protection are included in the book. Separate abstracts were prepared for 53 papers. Five papers were previously abstracted and appeared in NSA Vol. 20 as numbers 33338, 36857, 38575, and 45360 and Vol. 21 as number 1376. (B.S.L.)

For abstracts of individual papers see: 25346, 25400–25418, 25779–25798, 25818–25823, 25915–25917, 25990–25992, and 26005.

25779 EFFECTS OF IONIZING RADIATIONS ON PROTEINS. Braams, R. (Utrecht Univ.). pp 371-83 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Both in globular and fibrous proteins, irradiated in the dry state, in solution or in a state between solid and liquid, changes in the covalent bonded structure and in the secondary and tertiary structure were observed. In fibers the organization of the molecules was altered. The induced changes in conformation and organization represent an important aspect of radiation damage in proteins. The exact nature of the changes in covalent bonds are not yet known but it appears likely that much important information will be forthcoming in the next few years. (auth)

25780 DNA STRAND SCISSION AND LOSS OF VIABILITY AFTER X-IRRADIATION OF BACTERIAL CELLS. Kaplan, Henry S. (Stanford Univ. School of Medicine, Palo Alto, Calif.). pp 397-409 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Irradiation of Escherichia coli induced a decrease in sedimentation rate of alkali-denatured and native DNA, attributable to single- and double-strand scission, respectively. Single-strand scissions were repaired during reincubation of the irradiated cells, whereas double-strand scissions were not. BUdR increased the yield of double-strand scissions to the same extent (three-fold) as it increased radiation lethality. The radioprotective compound, MEA, produced a two-fold decrease in yield of double-strand scissions. Thymidine or purine starvation, or incubation with purine analogs, appeared to sensitize cells to x-rays by virtue of the summation of single-strand scissions developing during starvation with others randomly induced on the opposite strand by irradiation, producing an increased yield of double-strand scissions, again proportional to radiation lethality. It is concluded that double-strand scissions in DNA are the radiochemical lesions principally responsible for the lethal effect of ionizing radiation in Escherichia coli. However, single-strand scissions are probably important in radiosensitive mutants lacking the repair system, and perhaps also in cells grown under conditions in which repair is inhibited. (auth)

25781 EFFECTS OF ELASTIC NUCLEAR COLLISIONS ON BIOMOLECULES. Jung, H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 410-19 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The energy of charged particles is transferred to matter by excitations, ionizations, elastic nuclear collisions, and some other less frequent primary processes. While the biological consequences of excitations and ionizations were widely investigated in photobiology and radiation biology, only scarce information exists about the biological effectiveness of elastic nuclear collisions. In the experiments reported here extremely thin layers of ribonuclease were irradiated with slow protons and the differen-

tial inactivation cross-section determined for various proton energies. As protons of energies below 1 keV show a high efficiency for inactivating ribonuclease, it can be concluded that elastic nuclear collisions are able to destroy the enzymatic activity of ribonuclease. When cystamine is present during irradiation dry ribonuclease is protected against the action of "ionizing" protons (2 MeV), the dose reduction factor being 1.8. But no protection is observed when inactivation is achieved by elastic nuclear collisions (1.4 keV protons). Similar results were obtained when the irradiations were carried out at different temperatures. Using 2 MeV protons the radiosensitivity of ribonuclease was three times higher at room temperature than at 125°K, but when using slow protons of 1.4 keV energy the inactivation cross-section of RNase was independent of temperature. This showed that the action of elastic nuclear collisions can not be modified by cystamine or by low temperatures. (auth)

25782 LETHAL AND MUTAGENIC ACTION OF GAMMA-RAYS ON BACTERIOPHAGE DNA. Blok, Joh. (National Defense Research Organization TNO, Rijswijk, Netherlands). pp 423-37 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Ionizing radiation can affect living cells in several ways. One of these may be the action of free radicals produced in water on DNA, resulting in chemical alterations of the bases and breaks in DNA strands. Experiments were carried out with one-stranded DNA isolated from the Escherichia coli bacteriophage ΦX174 in order to compare the decrease of biological activity with the yield of chemical change. Moreover the induction of mutations by irradiation of this DNA in solution was studied. The bacteriophage production in bacterial spheroplasts was taken as a measure of biological activity. The contribution of chain breakage to inactivation was in general higher than expected. This is ascribed to secondary reactions producing multiple damage within one molecule. The yield of inactivation approximates the chemical yield of nucleotide alterations only in rather concentrated DNA solutions. The rate constant of nucleotides in DNA for reaction with free radicals is at least five times smaller than that of free nucleotides. Evidence is presented that in oxygen secondary reactions can take place between nucleotide radicals and DNA. Hydrogen peroxide and the O_2^- radical react very slowly with DNA. Both OH radicals and hydrated electrons or H radicals are reactive. SH compounds enhance the mutation induction in irradiated DNA solutions provided that the solution does not contain oxygen. The protection of cysteamine against inactivation reaches a maximum at pH 8. (auth)

25783 BIOPHYSICAL APPROACH TO GENETIC TRANSCRIPTION. Graziosi, F. (International Lab. of Genetics and Biophysics, Naples). pp 438-44 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The properties of phage α DNA are briefly discussed. The effects of x radiation on cells infected by phage α are described with respect to quantitative and qualitative changes produced on the synthesis of α messenger RNA. Results indicated the presence of a very large unit of transcription in phage α. (B.S.L.)

25784 EFFECT OF ULTRAVIOLET RADIATION ON GENES AND CHROMOSOMES. Wolff, Sheldon (Univ. of California, San Francisco). pp 455-65 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Ultraviolet radiation can induce both major kinds of genetic effects, intragenic and intergenic mutations. Most uv studies on the first type of mutation indicate that the effect is on DNA as is expected, since the gene is DNA. For the second group, those mutagenic events that come about from chromosome breakage, the data is more equivocal. There is a peak in the action spectrum that coincides with the peak in the absorption spectrum for DNA, but the entire action spectrum and many other features of the data can be interpreted to indicate that energy absorbed in protein breaks chromosomes and the lesions produced are in the protein of the chromosome rather than the nucleic acid. Although we know uv should be a more discriminating tool than x rays for elucidating chromosome structure and the nature of aberrations at the molecular level, there are many difficulties with its use that have yet to be overcome. (auth)

25785 SUBLETHAL X-RAY DAMAGE AND ITS REPAIR IN MAMMALIAN CELLS. Elkind, Mortimer M. (National Cancer Inst., Bethesda, Md.). pp 558-86 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Sublethal damage repair in x-irradiated Chinese hamster cells is reviewed and a model for the survival kinetics that accompanies the repair of sublethal damage is presented. Conclusions drawn were as follows: Chinese hamster cells can repair sublethal damage and this process is weakly temperature dependent and does not require oxygen; dose fractionation response with time consists of the combined process of repair and progression; protein inhibition by puromycin affected progression but not repair; inhibition of DNA by thymidine does not suppress repair; and the RNA inhibitor, actinomycin D, effectively reduces the capacity of a cell for sublethal damage without seriously retarding progress when low concentrations of the drug are used. (B.S.L.)

25786 RADIATION EFFECTS ON MAMMALIAN CELL POPULATIONS IN VITRO. Sinclair, Warren K. (Argonne National Lab., Ill.). pp 607-31 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Data are presented on the effects of x radiation on cultures of Chinese hamster cells. The radiation effects may be summarized as follows: a delay in the first division following exposure; a modification of synthetic processes in relation to DNA, RNA, and protein; increased frequency of chromosome and chromatid aberrations and total breaks; increased variability of colony size; and decreased cell survival. Each of these responses by the individual cell is entirely age-dependent. That this is true accounts for the complexities encountered in evaluating the effects of radiation on cell populations. (E.R.B.)

25787 SOLAR RADIATION: PRESENT AND PAST. De Jager, C. (Univ., Utrecht). pp 679-87 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The solar radiation spectrum consists of two parts: the photospheric spectrum, which contains the main radiation flux, and the secondary soft x-ray spectrum from the corona. The corona and the solar variability owe their existence to the convection region beneath the visible surface. During its contraction out of a primordial gas cloud the sun initially had a large radius, large luminosity and a low surface temperature; the sun was then surrounded by a dense corona emitting an intense and strongly variable x-ray flux. The corona disappeared after about 10^8 years, to reappear after about 1 or 2×10^9 years. During all phases of the past solar evolution the near uv radiation intensity was considerably less than its actual value. Table 2 gives the main characteristics of the sun during its past evolution; it also gives the temperature that a black body would have assumed at the distances of the earth and of the planetoids. During the last 4×10^9 years the solar radiation and temperature increased slightly; the consequent temperature of a black body at the earth's distance would have increased by 7° per 10^9 years. The major planetoids and the meteoritic material may have originated during the first 10^4 to 10^5 years of the sun's evolution. During that phase their temperatures must have been fairly high and perhaps somewhat variable, since the sun emitted a strong and, moreover, greatly variable radiation flux. (auth)

25788 PRESENT STATE AND PERSPECTIVES OF THE INVESTIGATIONS ON THE ORIGIN OF LIFE. Oparin, A. I. (Inst. of Biochemistry, Moscow). pp 688-99 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The process of evolution of carbon compounds that is the basis for the origin of life is operationally divided into three steps and experimental data and theoretical discussions of these steps are presented. It is noted that one of the main sources of energy at different stages of evolution was solar radiation; its influence and the role of short-wave radiation is discussed. (B.S.L.)

25789 ROLE OF RADIATION IN PRIMORDIAL ORGANIC SYNTHESIS. Ponnamperuma, Cyril (Ames Research Center, Moffett Field, Calif.). pp 700-13 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Energies that were available and effective for the synthesis of organic compounds under primitive earth conditions (primordial organic synthesis) are discussed; emphasis is placed on short-wavelength uv and ionizing radiations. Methods used in the laboratory to simulate primitive earth conditions are described and the effects of radiation on these environments and the resulting organic compounds are discussed. It was shown that molecules of biological significance, such as ATP, could be synthesized abiogenically by the action of ionizing or uv radiation. (B.S.L.)

25790 RADIATION AND THE FIRST BIOPOLYMERS. Fox, Sidney W. (Univ. of Miami, Coral Gables, Florida). pp 714-29 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

A theoretical discussion is presented on the sources of energy for the synthesis of polymers for the origin of a cell as a unit of life and the effects of radiation on such polymers. The life-related macromolecules primarily discussed are polyanhydro-α-amino acids and polynucleotides. The mechanism of synthesis of polymers of amino acids, proteinoids, from almost dry α-amino acids is also discussed. (B.S.L.)

25791 PHOTOPRODUCTS PRODUCED IN NUCLEIC ACIDS BY ULTRAVIOLET LIGHT. Johns, H. E. (Univ. of Toronto). pp 733-55 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Some of the properties of dimers and hydrates produced in pyrimidines are described and methods for irradiating materials with monochromatic radiation and for calculating the exposure given every molecule in the irradiation vessel are presented. Irradiation of uracil dimers (UpU) leads to three isomeric dimers of UpU as well as the hydrate. Irradiation of poly uracil (U) leads to dimers and hydrates. The cross-section for hydrate production in poly U is the same as in UpU. The total cross-section for dimer production in poly U is about the same as in UpU, but about $\frac{2}{3}$ of these dimers appear in dimer-rich sequences. Photoproducts in poly U are not produced at random but appear in clusters. When poly U is complexed to poly adenine (A) to give an ordered structure, hydrate production is reduced by a factor of 10 and dimer production by a factor of 5. The photochemistry of poly U complexed to poly A can be explained in terms of localized melting in which dimers are formed first distorting the ordered structure and then hydrates are placed in the poly U next to the dimer. The appearance of clusters of photoproducts could be explained by energy transfer taking place along the chain producing a photoproduct next to a pre-existing one. (auth)

25792 BIOLOGICALLY IMPORTANT DAMAGE TO DNA BY PHOTOPRODUCTS OTHER THAN CYCLOBUTANE-TYPE THYMINE DIMERS. Smith, Kendric C. (Stanford Univ., Palo Alto, Calif.). pp 756-70 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The biological importance of the cyclobutane-type thymine dimer is reviewed. It is pointed out that the dimer was not held 100% responsible for cell death in any one instance. Therefore, the relative roles of the other photoproducts of uv-irradiated DNA (pyrimidine hydrates, DNA-DNA cross-linking, chain breakage, and undefined photoproducts of thymine and cytosine), under conditions where the pyrimidine dimers appear to be of minor biological significance, are discussed and evaluated. (B.S.L.)

25793 HOST CELL REACTIVATION OF LETHAL AND MUTAGENIC EFFECTS OF ULTRAVIOLET LIGHT ON BACTERIA AND PHAGES. Winkler, Ulrich (Univ., Geneva). pp 790-99 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

A brief history of host cell reactivation (HCR) of lethal and mutagenic effects of uv radiation on bacteria and bacteriophages is presented and current literature on HCR is reviewed. Emphasis is placed on description and isolation of mutants defective in HCR; location of HCR-genes on the bacterial chromosome; HCR of mutagenic effects of uv radiation; requirement of double-strandedness of the DNA for HCR; release of thymine dimers from uv-irradiated DNA due to HCR; and specificity of HCR. In conclusion, a four-step scheme for HCR based on facts and assumptions is outlined and discussed. (B.S.L.)

25794 MECHANISM OF PHOTOSENSITIZED OXIDATIONS BY TETRAPYRROLIC PIGMENTS AND PHOTODYNAMIC ACTION. Krasnovskii, A. A. (Inst. of Biochemistry, Moscow). pp 813-22 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Data on a model photodynamic system where the triple system was studied are reviewed. The triple system consisted of electron donor (oxidized substrate) + chlorophyllous pigment + electron acceptor (oxygen). The excited state; the primary processes: photoreaction with oxygen and reversible photoreduction; photopheophytinization; and the sensitization mechanism are emphasized in the discussion of the data. It was indicated that the data confirmed the chemical mechanism of sensitization with the predominant participation of the triplet excited state of the sensitizer; two main types of reaction were realized for pigment regeneration: $P^* \xrightarrow{+O_2} \cdot PO_2^- \xrightarrow{+AH_2} P + H_2O_2$, $P^* \xrightarrow{+AH_2} \cdot P^- + \cdot AH_2^+ \xrightarrow{+O_2} P + A + H_2O_2$ where P is the photooxidized pigment and AH_2 is the oxidized substrate. (B.S.L.)

25795 KINETIC STUDIES OF THE PHOTODYNAMIC INACTIVATION OF TRYPSIN. Spikes, John D. (Univ. of Utah, Salt Lake City). pp 823-38 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Most enzymes can be inactivated photodynamically, i.e., by illumination in the presence of an appropriate photosensitizing dye and molecular oxygen. The fundamental kinetics of the process are discussed as illustrated by the effects of reaction variables such as light intensity, dye type and concentration, enzyme type and concentration, pH, temperature, oxygen partial pressure, and chemical protective agents on the quantum yields for inactivation. Information on the photodynamic effectiveness of different dyes as related to their chemical type and binding behavior to trypsin and other enzymes is presented. Kinetic data are discussed in terms of the several kinds of mechanisms that were suggested to explain photodynamic processes. Finally, some discussion of the biochemical changes occurring in enzymes during photodynamic inactivation is presented. (auth)

25796 NATURAL PHOTODYNAMIC SENSITIVITY IN RETINA AND CANCER CELLS. Santamaria, L. (Univ., Sassari, Italy). pp 839-56 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Data on the natural photodynamic sensitivity in retinae and in isolated Yoshida hepatoma ascites cells are reviewed. Methods used in the investigations are described. Results showed that the damaging effects of visible light on retinal enzymes were oxygen-dependent and that the choroid, when attached to the retina, somehow prevented this damage. X-ray treatment produced (on isolated retinae) oxygen-dependent enzymatic lesions of the opposite type with respect to those produced by visible light; treatment resulted in a dramatic inhibition of glycolysis together with a negligible diminution of respiration. In rat retina, respiration and glycolysis were affected to the same extent by irradiation with visible light under oxygen. It was also demonstrated that Yoshida hepatoma ascites cells were photosensitive in the presence of oxygen, i.e., they contained an active photodynamic system; this was consistent with the finding that ascitic fluid prevented light damage. These investigations also indicated the presence in tumor cells of pigments that were released into the surrounding liquid medium so that the ascitic fluid became strongly susceptible to photooxidation. (B.S.L.)

25797 KINETICS OF VIRUS INACTIVATION BY PHOTODYNAMIC ACTION. Hiatt, C. W. (National Inst. of Health, Bethesda, Md.). pp 857-68 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Kinetic analysis of photodynamic inactivation of viruses, a potential source of information about virus structure and function, is reviewed. Two speculations are described: one, photoinactivation of T3 coliphage sensitized with toluidine blue requires the destruction of four replicate targets, and two, transport of oxygen through the membrane or shell surrounding T2 coliphage proceeds at a relatively slow rate. An analog computer model for this kinetic system used to analyze survival curves is also described. (B.S.L.)

25798 PHOTOCHEMICAL AND -BIOLOGICAL REACTIONS OF THE FUROCOUMARINS. Farid, Samir; Krauch, Carl Heinrich (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). pp 869-86 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June-July 1966. See CONF-660614.

The furocoumarins reacting photochemically with phenanthrene quinone (PQ) or benzil, formed ketooxetane derivatives. With 1.4-naphthoquinone competition was observed between the cyclobutane and oxetane formation: from the furocoumarins and -chromones the oxetanes were predominantly formed, while coumarone gives both adducts. Duroquinone added to the furan double bond of the furocoumarins and -chromones yielding the corresponding cyclobutanes. Benzophenone sensitized the dimerization of xanthotoxin but added to visnagin. Photoexcited furocoumarins and other coumarin derivatives added olefins to the pyrone double bond forming cyclobutane adducts. The furochromones sensitize the dimerization of olefins, e.g., indene. Xanthotoxin gave a photodimer having the cyclobutane anti-head-to-head structure. By the dimerization of coumarin the fourth unknown C_4-cyclodimer was isolated. The solvent, temperature and concentration dependence of the reaction was investigated. The syn-dimers seem to be formed from coumarin aggregates existing in solution. Photoreactions of labeled psoralen with DNA and its components show that the furocoumarins react with thymidine and uridine probably under C_4-cycloaddition to the pyrone double bond. (auth)

Ecology

Refer also to abstract 27514.

25799 (A/AC.82/G/L-1187) OSOBENNOSTI MIGRATSII GLOBAL'NOGO TSEZIYA-137 IZ DERNOVO-PODZOLISTYKH PESCHANYKH POCHV PO PISHCHEVYM TSEPOCHKAM V ORGANIZM CHELOVEKA. (Characteristics of the Migration of Global ^{137}Cs From Podzolic Turf Soils to the Human Organism Through Food Chains). Moiseev, A. A.; Mukhin, I. E.; Pogodin, R. I.; Antropova, Z. G.; Filimonov, G. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 22p. (In Russian). Dep.

During the migration of ^{137}Cs from podzolic turf soils through food chains, the increased content (in comparison with other soils) of ^{137}Cs in vegetables, in agricultural products (meat and milk), and in the people living in this area was noted. The transfer coefficients were tabulated for a number of vegetables, meat, and milk. The increased content of ^{137}Cs in the links of the food chain — vegetable-animal products-man — is determined by the specific composition of the soil. The mean content of ^{137}Cs in the adults was 55 nCi in all tissues. In one of the men examined it was 110 nCi. The dose of internal radiation to adults from the incorporation of ^{137}Cs varies from 3 to 17 mrad/yr and the average is from 8 to 10 mrad/yr. (tr-auth)

25800 (UCLA-12-668, pp 37-58) ENVIRONMENTAL RADIATION. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

ANGIOSPERMIDAE — survival of winter annual, in Northern Mojave Desert; Salsola kali, radiation effects on germination of seeds of, γ
MICE — radiation effects on populations of Peromyscus sp., effects of continuous exposure on γ; metabolism in Perognathus formosus, deuterium and oxygen-18 tracer studies of
FISSION PRODUCTS — cycling in agricultural systems
STRONTIUM-90 — uptake by barley and beans, effects of clinoptilolite on reduction of
ECOSYSTEMS — radiation effects on, at Nevada Test Site
SOILS — radioisotope analysis of, at Eniwetok
REPTILIA — Uta stansburiana, radiation effects on natural populations of, γ; lizards, activity ranges of, analysis of variation in
NEVADA TEST SITE — radioecology of arthropods at
RADIOISOTOPES — uptake by bush bean plants, cesium-137 and rubidium-86; content of bones, feces, plants, soils, and water
CALCIUM — effects on micronutrients of plants (H.L.W.)

Genetics and Cytogenetics

Refer also to abstracts 25755, 25782, 25784, 25872, 25992, and 26003.

25801 (COO-332-2) TECHNICAL PROGRESS REPORT [ON YELLOW-VIRESCENT CHLOROPLAST PIGMENT MUTATION IN BARLEY]. [Snyder, L. A.] (Minnesota Univ., Minneapolis). Jan. 2, 1968. Contract AT(11-1)-332. 8p. Dep. CFSTI.

Mutations — analysis of chemical- and radioinduced, in yellow-virescent chloroplast pigments of barley
Pigments — content of chloroplast, in barley seedlings, effects of age and temperature on

25802 (JPRS-42635, pp 65-71) PHYSIOLOGICAL REGENERATION OF THE EPITHELIUM OF THE CORNEA AND INTESTINE UNDER CONDITIONS OF FRACTIONAL IRRADIATION BY FISSION NEUTRONS. Mastryukova, V. M.; Strzhizhovskii, A. D. Translated from Kosm. Biol. Med., 1: No. 2, 43-7(1967).

A study was carried out to determine the mitotic index and content of chromosomal aberrations in the epithelial cells of mice exposed to various fractional doses of fission neutrons. Under these conditions compensatory processes increasing the tissue resistance to further irradiations developed in the epithelium of the cornea and intestines. This eliminated an increasing damage of mitotic activity and the genetic structures of cells. Therefore, the tissues developed an equilibrium state whose characteristics depended on the dose rate. (JPRS)

25803 TOMATO MUTANT FORM WITH FLOWER DEFORMATIONS. Abadjieva, M. (Inst. of Genetics and Plant Breeding, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1349-52(1967).

A tomato mutant with strong deformation of flowers and fruits that was obtained by γ irradiation of air dried seed at a 20.000 R dose is described. Cytoanatomical and cytoembryological analyses of the flower buds and flowers were made; morphological examinations were made on the fruits. Artificial pollination with a fertile pollen from a part of the initial variety produced no results that indicated that in addition to deformations in the morphological and anatomical structure of the flower, deformations were also caused by the radiation in the process of growth and formation of the female gametophyte. (B.S.L.)

25804 ACTIONS OF RADIATIONS ON CHROMOSOMES. Evans, H. J. (Univ. of Aberdeen, Scotland). Sci. Basis Med., Ann. Rev., 321-39(1967).

Effects of ionizing radiations on chromosomes are reviewed (49 references). By use of the peripheral blood culture method radiation-induced chromosome damage can be studied in leucocytes obtained from individuals exposed to radiation accidentally or for therapeutic purposes. These techniques were used to test the sensitivity of human cells to radiation-induced chromosome damage, to compare this sensitivity with other animal cells and with plant cells, to determine whether the response of cells irradiated in vitro in whole blood immediately following its removal from the body is the same as the response of the cells irradiated in vivo, and whether the sensitivity of the cells is changed after they have been transformed by exposure to phytohemagglutinin (PHA) and have developed into blast cells. After irradiation of interphase cells and examination of these cells at the first post-irradiation mitosis, two basic types of chromosome structural change were observed. In cells exposed while in early interphase (G_1) all the aberrations were a consequence of breaks or exchanges involving the whole chromosome, both chromatids being affected in exactly the same way and at identical loci (chromosome type aberrations). If radiation exposure was delayed until the cell entered into the DNA synthesis period (S), or was in the post-synthetic interphase period (G_2), the aberrations induced were of the chromatid type, where the unit of change was not the whole chromosome but the half chromosome of chromatid. Chromosome-type and chromatid-type changes are described. Results were surveyed which indicated that the chromosomes in human peripheral blood small lymphocytes were more sensitive to radiation damage than supposed. Some studies carried out on individuals exposed to ionizing radiations are reported. (BBB)

25805 THE NATURE OF PRIMARY CHROMSOME INJURIES IN CONNECTION WITH THE PROBLEM OF POSTIRRADIATION RECOVERY. Luchnik, N. V. (Inst. of Medical Radiology, Obninsk, USSR). pp 118-34 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Pea seeds and sprouts were irradiated with ^{60}Co γ rays and chromosome aberrations were analyzed in the anaphases; in each preparation, 50 anaphases were analyzed and mitotic activity was determined. It was found that the primary chromosome injury consisted of a reversible change of its matrix properties that recovered in the course of time and under the influence of accompanying factors. If they had not recovered by the moment of realization, irreversible changes occurred that were localized mainly in the daughter chromatids. The transition of the primary injuries into ones that were irreversible was accomplished during

two stages of the cell cycle, in transition from S to G_2 (chromosome reduplication) and from G_1 to S. (JPRS)

25806 INFLUENCE OF MOISTURE AFTER IRRADIATION ON DEGREE OF RECOVERY FROM CYTOGENETIC INJURIES. Fesenko, E. V. (Inst. of Medical Radiology, Obninsk, USSR. Inst. of Biology, Sverdlovsk, USSR). pp 155-9 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Peas of the Kapital variety containing 16 and 10% moisture in one experiment and 16 and 9% in another were irradiated with ^{60}Co γ rays (15,000 R at 50 R/minute) and stored in desiccators with different relative humidity for 24 hours in the first and three days in the second experiment. Dry and moist seeds were stored at both high and low relative humidities. At various times after irradiation, the seeds were moistened and germinated at 26°. Chromosome aberrations were determined in the anaphases of the root meristem at the end of the first mitosis. It was found that the moisture of the seeds after irradiation was a factor determining the effect of irradiation; increasing the relative humidity during storage reduced radiosensitivity and storage in a dry atmosphere increased it. (JPRS)

25807 REASONS FOR VARIATION OF RADIOSENSITIVITY OF SEEDS AT DIFFERENT STAGES OF SWELLING AND GERMINATION. Shishenkova, L. K. (Inst. of Medical Radiology, Obninsk, USSR. Inst. of Biology, Sverdlovsk, USSR). pp 152-4 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Pea seeds of the Kapital variety were soaked in distilled water for 24 hours at 24 to 25°C, placed on moist sand in Petri dishes for germination and γ-irradiated with ^{60}Co at a dose of 800 R/minute before or after soaking in the course of 6, 12, 18, 24, 30, 36, 42, 48, and 54 hours; the root tips were fixed 50 hours after the end of soaking. Chromosome aberrations of various types were analyzed in the anaphases and early telophases of the root meristem and the percentage of primary injured cells determined. It was found that the main reason for variation of the radiosensitivity of the seeds during the swelling and germination was a change in the conditions of postirradiation recovery. (JPRS)

25808 EFFECT OF COLCHICINE ON CHARACTER OF RADIATION-INDUCED CHROMOSOMAL ABERRATIONS. Poryadkova, N. A. pp 150-2 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Experiments were conducted on peas γ-irradiated at a dose of 300 R at a rate of 38 R/min and 5 hr later soaked in a solution of colchicine for 2 hr. It was found that colchicine, while not affecting the total number of chromosomal aberrations induced by irradiation, quite definitely changed their ratio. The change in the ratio between paired straight fragments and curved fragments was statistically significant. Thus colchicine affected the character of formation of chromosomes from chromatids in the same manner as irradiation. (ATD)

25809 EFFECT OF EDTA ON RADIATION LESIONS OF CHROMOSOMES. Tsarapkin, L. S. pp 142-50 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

In experiments carried out with pea sprouts it was demonstrated that when the sprouts were placed in a solution of ethylenediamine tetraacetate (EDTA) for two hr before or after γ radiation with a dose of 800 R at a rate of 37.5 R/min. there was an increase in the percentage of cells with chromosomal aberrations which was due exclusively to an increase in the number of fragments. EDTA did not affect the number of primary lesions but inhibited the reparation process, increasing the probability of chromosomal damage. Depending on the duration of exposure to EDTA, its effect could be manifested by inhibition of local or cellular repair. The effect of EDTA was explained by its action on those intracellular systems which were related to the reparation of radiation lesions, whose recovery of normal activity promoted the recovery of cells from potential damages. (ATD)

25810 OXYGEN AFTER EFFECTS ON IRRADIATION OF BEAN SPROUTS. Mikhel'son, V. M. (Inst. of Cytology, Leningrad). pp 159-62 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Four-day sprouts of Vicia faba with rootlets 5 to 6 cm long were kept without air ten minutes before x irradiation (200 R at 920 R/minute). At various times (10 sec to 10 min) after irradiation, oxygen was passed through the container for one minute and then anaerobic conditions were restored by purging with pure nitrogen. Two hours after irradiation, pressure preparations were made of root ends 4 to 5 mm long and the percentage of anaphases with conglomerate chromosomes was determined. It was found that lasting oxygen-sensitive states could be preserved about 30 minutes after irradiation and that about half the total oxygen effect could be attributed to those states. (JPRS)

25811 THE INFLUENCE OF INHIBITORS AND ACTIVATORS OF CELLULAR METABOLISM ON THE NUMBER OF CHROMOSOME ABERRATIONS AFTER SINGLE-DOSE AND FRACTIONATED GAMMA IRRADIATION OF BARLEY SEEDS. Nuzhdin, N. I.; Dozortseva, R. L.; Samokhvalova, N. S. (Inst. of Genetics, Moscow). Tr. Inst. Genet., Akad. Nauk SSSR., No. 32, 4-17 (1965). (In Russian).

Air-dried seeds of two varieties of winter barley, Odessky 17 and wintering maskovsky, were irradiated with ^{60}Co gamma rays in a dose of 15 krad with dose power of 301 rad/min. Seeds were irradiated by two methods, in one dose and in two doses of 7.5 krad each separated by an interval of 15 days. Twenty-four hr after the first irradiation by the fractionated method, and 24 hr after single irradiation, seeds were soaked for 24 hr in solutions of levomycetin, straptomycin, ATP, and water. The yield of cells with chromosome aberrations (acentric fragments and dicentric bridges) in primary rootlets sprouted from treated seeds was counted. The percentage of cells with abnormal mitoses served as an index of the radiation effect. Experimental results showed that fractionated irradiation caused a weakening of the effect of gamma irradiation. Analysis showed the first dose to be twice as effective as the second. The lesser effect of the second dose determined the decrease in the total radiation effect. Of the three substances used (levomycetin, streptomycin, and ATP) during single irradiation, only streptomycin and ATP considerably reduced the percentage of chromosome aberrations as compared with seeds soaked in water. With fractionated irradiation, differences were established only for the Odessky 17 variety with streptomycin. (ATD)

25812 LETHAL MUTATIONS AND BALANCED LETHAL SYSTEMS IN ASPERGILLUS NIDULANS. Azevedo, J. L. (Univ. of Sao Paulo, Brazil); Roper, J. A. J. Gen. Microbiol., 49: 149-55 (Oct. 1967).

The frequency of spontaneous and uv-induced, recessive lethal mutations was estimated in two diploid strains of A. nidulans. The parent diploids were heterozygous for recessive and semidominant markers; each recessive lethal resulted in failure to recover haploid strains carrying the allele linked in coupling to that lethal. Diploids one and two carried markers permitting direct assay of lethals on four and eight chromosomes, respectively, out of the total diploid complement of 16. No lethals were detected in 100 isolates from each untreated diploid. One hundred isolates from each uv-treated parent yielded six and 16 lethals, respectively, suggesting a frequency for the whole genome, at 5% survival, of about 28% lethals. The lethals were nutritionally irreparable and were not temperature-sensitive. Several of them were located roughly by mitotic crossing-over. One isolate was heterozygous for two unlinked lethals. It segregated to give a stable heterokaryon bearing two classes of nonviable haploid conidia. Meiotic analysis, via a three-component heterokaryon, showed that the stable heterokaryon was balanced by the non-allelic lethals, one in each haploid component. Another isolate had a balanced lethal system resulting from linked, non-allelic lethals in trans. Six isolates from uv treatment were stable diploids which produced no haploid sectors. (BBB)

25813 EFFECT OF SECONDARY COSMIC RAYS ON SPONTANEOUS MUTABILITY. Sosna, M. (Inst. of Experimental Botany, Prague). Biol. Plant. Acad. Sci. Bohemoslov., 9: 473-5 (1967).

Attempts to detect mutations induced by cosmic radiation are reported. Currently used controls for such tests, i.e., exposure of samples at the surface of the earth at low altitudes, were not really valid because zero dose values could not be obtained. Efforts to get as near to zero dose values as possible led to a study of biological materials below the surface of the earth, although the meson component could be physically registered hundreds of meters below the earth. With the biological material tested, Equisetum arvense, E. silvaticum, and E. palustre, the detection of abnormal plastids in the cells of prothalli was used as a criterion of mutation. The frequency of these abnormalities had a significant stability, as shown in the course of a four-yr study. Irradiation of the spores of a given species of Equisetum at the beginning of germination by ionizing radiation led to a disturbance in the division of plastids and to a deformed shape. To study the effects of cosmic rays, cultivation of the prothalli of Equisetum

was carried out in sterile surroundings in agar medium in chambers with artificial light (spectrally strictly defined sources). Simultaneously sown spores on Petri dishes, in triplicate, were exposed at two sites: on the surface of the earth (altitude 250 m above sea level) and underground (at a depth of 1340 m). After 18 days' exposure, the germination of spores, development of prothalli, and numbers of cells with abnormal plastids were evaluated. The results showed similar results in all three species of Equisetum. The differences between exposure at +250 m and −1340 m were significant for the percentage of prothalli with abnormal plastids (0.0093, 0.0084, and 0.0078%, for the three species, respectively at +250 m compared with 0.0015, 0.0014, and 0.0014% at −1340 m). However, no significant difference in germination percentage was noted. (BBB)

25814 UNSTABLE MUTATION FORMS INDUCED BY UV IRRADIATION. Sedliakova, M.; Slamenova, D. (Inst. of Biology, Bratislava). Folia Microbiol. (Prague), 12: 323-6 (1967).

The stability of prototrophic reversions induced by uv irradiation was studied in the auxotrophic strain Escherichia coli WP_2 to establish the relation between retarded growth and instability of reversion to prototrophy. This tryptophan-requiring strain, during the exponential phase of growth, was irradiated with a Philips lamp (500 erg/cm^2) and inoculated onto minimal solid media. When determination of the fraction of prototrophs was carried out after the seventh transfer of the slowly growing clones a highly significant drop of the prototroph fraction was observed in six clones, after the thirteenth transfer in eight clones, and after the nineteenth transfer in 10 of the 11 clones investigated. During transfers of the rapidly growing clones a highly significant drop of the prototroph fraction was seen in three clones after seven transfers and in four clones after 13 and 19 transfers. After a single transfer no decrease in the prototroph fraction was observed. The fraction of prototrophic cells varied between 10^{-7} and 10^{-8}, i.e., at a level of occurrence of spontaneous mutations. Thirteen of the 20 prototrophic clones with retarded growth showed normal growth on subculturing in a minimal medium. The remaining seven clones grew in the presence of the essential nutrient but in its absence were retarded. With transfers through the liquid complete medium further changes in the growth of these clones were observed. In five the reversion took place either suddenly or gradually so that, alongside minute colonies, the minimal media displayed colonies of normal size. In unstable reversions the retarded growth was caused by a limited and variable ability to synthesize the essential nutrient. The irregularity observed in the synthesis of the essential substance and the high frequency occurrence of auxotrophic forms indicated that these changes were brought about by a region regulating the transmission and expression of genetic information. (BBB)

25815 RADIATION GENETICS. Wolff, Sheldon (Univ. of California, San Francisco). Annu. Rev. Genet., 1: 221-44 (1967).

The distinction between true mutations and chromosomal aberrations, studies on induction of such aberrations, the site hypothesis, studies on chromosome structure, effects of endogenous radiations, and radiation studies on the fine structure of chromosomes were reviewed. Criteria that arose from radiation studies, by which it was possible to distinguish between the nebulous class of true mutations and that of gross chromosomal effects, were examined, namely the shape of the dose curve, one-hit versus two-hit, the occurrence or nonoccurrence of intensity and fractionation effects, and ion density independence vs dependence. The controversy regarding the studies used to obtain the radioinduced mutation rates in mice was surveyed before estimating genetic hazards of radiations to human populations. Evidence that the mutations observed were really chromosomal aberrations rather than true point mutations was reviewed. Although ionizing radiation can induce true mutations, many of the radioinduced mutations that were studied could have been the result of chromosome breakage and rejoining. Most mutagenic events induced by radiation fell into the latter class. Possible mechanisms for the production of chromosomal aberrations in irradiated cells were described and models for the interactions of radiations with chromosomes formulated. It was pointed out how radiation had been used to gather information regarding the strandedness of chromosomes and the chemical nature of the bonds formed when breaks rejoined. It was concluded that at a fundamental level, radiation genetics could not yet precisely define the radioinduced mutagenic lesion. (BBB)

25816 COMPARISON OF RADIATION-INDUCED CHROMATID ABERRATIONS IN THE TESTES AND BONE MARROW OF THE CHINESE HAMSTER. Brooks, Antone L.; Lengemann, Frederick W. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-2147. Radiat. Res., 32: 587-95(1967).

Cells from the testes and bone marrow of the Chinese hamster were sampled at six hours after the end of exposure to ^{60}Co γ irradiation, and the number of chromatid-type aberrations was scored in an attempt to measure radiosensitivity. By varying the dose, the radiosensitivity (the number of single-hit breaks per cell per roentgen) was calculated to be 0.0015 for the bone marrow and 0.0041 for the testes. This indicated that the number of chromatid deletions observed in a somatic tissue may not reflect the number produced by the same dose of radiation in a reproductive tissue. The change in the chromatid breakage frequency as a function of time after irradiation was also measured. These results indicated that the number of chromatid aberrations observed in each of the two tissues was dependent on the time interval between irradiation and sampling of the cells. Ratios of the number of breaks in the chromosomes of the testes divided by those in the bone marrow had values ranging over time from 1.34 to 3.19. It was concluded that several different time intervals of sampling must be used to characterize the radiosensitivity of any previously unmeasured tissue. (auth)

25817 BIOLOGICAL ACTION OF FISSION NEUTRONS ON THE CELLS OF THE INTESTINAL EPITHELIUM. Mastryukova, V. M.; Strzhizhovskii, A. D. Radiobiologiya, 7: 398-403(1967). (In Russian).

On irradiation of mice with neutrons at doses of 20 to 200 Rad in the biological channel of a nuclear reactor, the degree of suppression of the mitotic activity in epithelial cells of duodenal cryptae increased exponentially with an increase in dose. The median effective dose was 45 Rad. The number of chromosome aberrations in the first mitotic cycle after irradiation also increased exponentially with an increasing magnitude of the dose. The median effective dose in this case was 155 Rad. Cells with damaged genetic structure lost the capacity for unlimited reproduction: the mean number of divisions of cells with aberrations after irradiation with 200 Rad was 2.9. Irradiation in the range of doses applied did not alter significantly the number of cells in the epithelium of cryptae and villi, i.e., the genetic damage was not associated with interphase destruction of cells. Because of the higher rate of restoration and replacement of cells in the intestinal epithelium, the decrease in the number of cells after irradiation at 200 Rad did not correspond to that occurring in the cornea after irradiation at the same dose; the genetic apparatus was affected to approximately the same degree. On the basis of the genetic effect, the relative biological effectiveness of fission neutrons was 3.6 with reference to x rays. On the basis of the physiological effect produced, the relative biological effectiveness of neutrons was much lower. (JPRS)

25818 CHROMOSOME ABERRATIONS, CELL KILLING, AND THE MOLECULAR BASIS OF RELATIVE BIOLOGICAL EFFECTIVENESS OF IONIZING RADIATIONS. Neary, G. J. (Radiobiological Research Unit, Harwell, Eng.). pp 445-54 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Chromosome aberration data are summarized and interpreted on the basis of a model that predicts there are two modes of production of aberrations. One, the primary lesions in the two chromosomes or the two parts of the same chromosome are produced by separate ionizing particles; the yield is then approximately proportional to the square of the dose and there is little dependence on LET. Two, the two lesions are produced by a single ionizing particle; the yield is approximately proportional to dose and also to LET. It is concluded that a primary lesion which subsequently interacts with a similar lesion to produce an aberration is produced by a single energy-loss event in a minute structure; this structure was indicated to be a DNA macromolecule and the lesion a single scission of one of the two strands. Similarities and differences between the phenomena of chromosome aberrations and cell death in relation to RBE and LET of protons and soft x-rays are enumerated. (B.S.L.)

25819 PROGRESS IN MAMMALIAN RADIATION GENETICS. Searle, A. G. (Medical Research Council, Harwell, Eng.). pp 469-81 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Genetic damage that results from irradiation of mice under varying conditions is reviewed. Emphasis is placed on techniques for comparative study of genetic damages, i.e., reciprocal translocation detection in premeiotic cells and the effects of radiation on litter size; use of specific locus method to study induction of recessive mutations and the effects of different doses, dose-rates, LET, and sex on the mutagenic effects; detection of hidden domi-

nant mutations; and the effects of spermatogonial x-irradiation of many generations of mice. (B.S.L.)

25820 REPAIR AND RECOVERY FROM CHROMOSOME DAMAGE INDUCED BY FRACTIONATED X-RAY EXPOSURES. Evans, H. J. (Univ. of Aberdeen, Scotland). pp 482-501 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

An interpretation of the events leading to chromosome aberrations drawn from experimental data on anaphase bridges and dicentric, fragmentary, and ring aberrations of chromosomes in x-irradiated root-tip cells of barley, peas, Vicia faba, and in chromosomes of human leukocytes is presented. A lengthy discussion is given on a hypothesis that states that radiation does not immediately break chromosomes but that it produces damaged zones or lesions on the chromosomes immediately following exposure and that these lesions are initially reactive or unstable but then become stabilized. Some time after their stabilization, the lesions undergo a repair process such as that known for bacteria. A scheme depicting how the events occur is outlined. The hypothesis is concluded with the idea that chromosome aberrations are a consequence of mis-repair. (B.S.L.)

25821 REPAIR AND RADIOSENSITIVITY PHENOMENA IN DROSOPHILA MALES. Sobels, F. H.; Michael, B.; Mukherjee, R.; Olivieri, G.; Olivieri, A.; Sankaranarayanan, K.; Watson, W. A. F. (Univ., Leiden. Inst. for Radiopathology and Radiation Protection, Netherlands). pp 502-21 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

When Drosophila males are exposed to x irradiation given at a high dose-rate under anoxia, and the effects of post-treatment with N_2 are compared to those with O_2, a reduction of the mutation and translocation frequencies is observed with N_2 in spermatozoa, but with O_2 in early spermatids. Since the same results have now been obtained with spermatozoa, treated in inseminated females, and with spermatids from 24-hour-old pupae, these post-radiation modifications cannot be due to errors in the sampling of germ cells with different radiosensitivities. Experimental evidence suggests that in both types of cells the post-radiation effects arise from enzymatic repair of potential lesions, leading to mutation or chromosome breaks. Since all mutation frequencies were obtained from a ring-shaped X-chromosome, it is not probable that the post-radiation modifications reflect an effect only on lethals associated with chromosome breakage events, but at least to some extent can be considered as an indication for repair of pre-mutational lesions. Data obtained for dominant lethals in both stages indicate that selective elimination of cells with mutations can also be ruled out in the interpretation of these results. For sperm it was demonstrated that post-radiation interaction of radicals with O_2 cannot explain the observed effects. Radiosensitization observed following pre-treatment with sodium fluoride, iodoacetamide, ribonuclease, actinomycin D and puromycin suggests that in sperm both glycolytic enzymes and RNA or protein synthesis might be involved in the repair process. In the early spermatids, on the other hand, oxygen is clearly required for repair to occur, and inhibition of RNA and/or protein synthesis by pre-treatment with actinomycin, ribonuclease or chloramphenicol leads to a reduction of the radiation-induced mutation frequency. The observation that in early spermatids more repair is observed at low than at high doses, suggests that the O_2-dependent repair system can more effectively handle a limited amount of damage, but may become saturated at the higher doses of irradiation. A peculiar inverse effect of dose-rate has been observed for the early spermatid system, in that at lower dose-rates the damage remains unrepaired. (auth)

25822 BACTERIAL GENES AND ENZYMES INVOLVED IN THE RECOVERY FROM LETHAL ULTRAVIOLET DAMAGE. Rorsch, A. (National Defense Research Organization TNO, Rijswijk, Netherlands); Van De Putte, P.; Mattern, I. E.; Zwenk, H.; Van Sluis, C. A. pp 771-89 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

A survey of radiation-sensitive mutants of Escherichia coli is presented. According to their phenotypes, five classes were distinguished: mutants in which the ability to divide after x- or uv-irradiation is reduced; uv-sensitive mutants that have lost the ability to repair uv lesions in bacteriophage DNA; uv-sensitive mutants that have not lost the ability to repair uv lesions in bacteriophage DNA; uv-sensitive mutants that are in addition x-ray sensitive; and uv-sensitive mutants that are x-ray sensitive and in addition defective in genetic recombination. Attention is focused on the various linkage groups on the bacterial chromosome that were recognized and to which each of the mutations involved proves to belong. A cell-free system for the demonstration of repair of uv-irradiated DNA is described. (auth)

25823 PHOTODYNAMIC EFFECTS ON EUGLENA. Bellin, Judith S. (Polytechnic Inst. of Brooklyn, N. Y.). pp 896-904 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Investigations were made to determine whether mutations could be produced in Euglena gracilis by photodynamic means. The effectiveness of light and dyes, such as crystal violet, methylene, blue, neutral red, and rose bengal, on the frequency of uv- and x-radioinduced mutations was determined. Both colorless mutants and petite colonies were produced by the action of light and dyes; however, when a large number of controls was carefully examined and the light intensity during growth was controlled within strict limits, it was concluded that the mutations did not occur at ratios that were significantly different from those noted in controls. Sifting for amino acid dependence likewise gave negative results. (B.H.S.)

25824 CHROMOSOMAL ABERRATIONS INDUCED BY TRITIATED THYMIDINE DURING THE S AND G_2 PHASES OF CHINESE HAMSTER CELLS. Dewey, W. C. (Colorado State Univ., Fort Collins); Sedita, B. A.; Humphrey, R. M. Int. J. Radiat. Biol., 12: 597-600(1967).

The frequency of chromosomal aberrations induced by different durations of chronic irradiation from tritium-labeled thymidine (^{3}HTdR) incorporated into the DNA of Chinese hamster cells was measured. Labeled cells were incubated for either 4 or 9 hours before fixation. The total number of disintegrations of the ^{3}HTdR incorporated into labeled metaphase cells was calculated from autoradiographic data, and the chromosomal aberrations were scored in metaphase cells. In cells incubated for 4 hours (primarily G_2-phase irradiation) more chromosomal aberrations were induced than in cells incubated for 9 hours (primarily S-phase irradiation). (M.M.B.)

25825 PILOT STUDIES OF THE CELL POPULATION KINETICS IN IRRADIATED TUMOURS. Revesz, L.; Lindfors, P. (Karolinska Institutet Medical School, Stockholm). Eur. J. Cancer, 3: 329-33(Nov. 1967).

Diploid and tetraploid cell lines, both derived from the same Ehrlich ascites tumor, were mixed together in varying proportions. The resulting cell populations were grown in mice by serial intraperitoneal transfers. At regular time intervals, the relative proportion of the two cell types was determined by chromosome analysis of colchicine treated populations. In all cases, the frequency of diploid cells increased gradually until a constant level was reached. The length of the growth period, necessary for the shift, was inversely related to the initial proportion of diploid cells. The observational data were in a good agreement with a theoretical kinetic model defined by an independent, average growth rate of the diploid and tetraploid subpopulations, and the occurrence of endomitotic processes in diploid cells giving rise to tetraploid cells at a constant rate. The numerical value of the kinetic parameters, calculated by mathematical formulas which were developed on the basis of the model, agreed well with previous estimates. The role of the particular kinetics in the development of radioresistant cell populations was discussed in view of the greater radioresistance of tetraploid cells as compared to diploid cells. (auth)

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Refer also to abstracts 25529, 25532, 25543, 25544, 25568, 25635, 25752, 25799, 25800, 25919, 25932, 25933, 25961, 25978, 25992, and 27465.

25826 (CEA-R-3347) ETUDE DE LA PENETRATION DES AEROSOLS DANS LES COUCHES FILTRANTES. (Study of Aerosol Penetration into Filtering Layers). Parnianpour, Hassan (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1967. 58p. (In French). Dep.

Thesis. Submitted to Faculte des Sciences, Univ. of Paris, France.

In this work a radioactive aerosol is used to study the penetration of particles inside various filtering media by a layer technique. First of all the penetration of the active thoron deposit fixed on the atmospheric dust was examined for a series of filters which were considered to be representative of the various filtering ma-

terials used. From this series of tests it appears that the penetration of an ultrafine aerosol in a filter made up of fibrous matter involves two different processes: the first part of the curve characterizes the surface effect, the second part which is practically exponential in form has a slope which depends on the test conditions and on the nature of the filter. The changes in the penetration as a function either of the porosity or of the rate of filtration yield only a qualitative check of the theory; in all cases the penetration is much greater than predicted. The last part of the work is devoted to an examination and a discussion of results obtained, and to various applications of the method, especially concerning the determination of the absorption coefficient for α particles by the matter. The changes in the absorption factor with filtering speed are particularly studied. (auth)

25827 (NP-17204) TSEZII-137 I STRONTSII-90 V TYULENYAKH I OKEANICHESKIKH RYBAKH. (^{137}Cs and ^{90}Sr in Seas and Ocean Fishes). Polikarpov, G. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 15p. (In Russian).

The content of ^{90}Sr, in contrast to that for ^{137}Cs, in marine vertebrates varies comparatively little in different species. The concentration of ^{90}Sr in fish from the southern Atlantic and northwestern part of the Indian Ocean in 1966 does not differ statistically from one to the other. The content of ^{90}Sr in seals from the Okhotsk Sea in 1966 is comparable with its concentration in fish from the Atlantic and Indian Oceans in the same year. (tr-auth)

25828 (NP-17440) GUIDANCE FOR THE CONTROL OF RADIATION HAZARDS IN URANIUM MINING. Report No. 8, Revised. (Federal Radiation Council, Washington, D. C.). Sept. 1967. 60p. GPO $0.40.

The radiation environment associated with uranium mining, biological effects associated with exposure to radon and radon daughters with special reference to lung cancer, and control capabilities in uranium mines are discussed. Recommendations for radiation protection in uranium mines are presented. (W.H.K.)

25829 (NYO-2577-8) A STUDY OF NATURAL RADIOACTIVITY IN BRAZIL. Cullen, Thomas Lynch (Pontificia Universidade Catolica do Rio de Janeiro (Brazil). Instituto de Fisica). Oct. 31, 1967. Contract AT(30-1)-2577. 68p. Dep. CFSTI.

NATURAL BACKGROUND RADIATION — detection and measurement in monazite areas of Brazil, use of thermoluminescent dosimeters for

RADON-220 — dosimetry in atmosphere of Brazil, use of scintillation flask for

MAN — thoron body burden of, in Brazil, use of breath analysis and whole-body counting for determination of

ATMOSPHERE — thorium activity in, of lamp factory in Brazil by scintillation flask, double filter apparatus, and Casella cascade impactor

PERSONNEL — thorium detection and measurement of thorium activity in, of lamp factory in Brazil by whole-body counting

SUGARS — gamma ray attenuation in determination of coefficient of

PLANTS — radiochemical assay of, in Brazil for lead-210, radium-228, and thorium-228 (H.W.)

25830 (SC-RR-68-110) TUNNEL DECONTAMINATION OF FISSION PRODUCTS. Crites, Thomas R. (Sandia Corp., Albuquerque, N. Mex.); Hopper, Donald M. (REECo, Mercury, Nev. Radiological Sciences Dept.). Mar. 1968. Contract AT(29-1)-789. 20p. Dep. CFSTI.

After a tunnel complex at Nevada Test Site was contaminated by a nuclear event, decontamination procedures were used to allow rapid rehabilitation of the tunnel. The methods used and effectiveness of each are presented. (auth)

25831 (JPRS-42635, pp 1-6) RADIATION AND SPACE FLIGHT. Grigor'ev, Yu. G.; Kovalev, E. E.; Pravetskii, V. N. Translated from Kosm. Biol. Med., 1: No. 2, 3-6(1967).

A discussion of the efforts of different specialized scientific research and planning-design organizations of the country that should be combined for ensuring the radiation safety of space flight personnel is presented. Emphasis is placed on the need for study of cosmic radiation effects on man and the need for development of an operative medical control that uses on-board and ground-based computers. (B.S.L.)

25832 USEFULNESS OF MEAT OF ANIMALS EXPOSED TO IONIZING RADIATION. Vranovska, J.; Pawel, O.; Kalousova, V. (Veterinary Research Center, Prague). Voj. Zdravot. Listy, 35: 261-3(Dec. 1966). (In Czech).

It was possible to use meat from animals that were subjected to radiation, when such animals are killed before clinical aspects of radiation sickness had developed. The meat was suitable for use in smoked meat products. No differences between the fresh products were discovered; however, during storage the irradiated meat showed larger weight losses, and the products deteriorated more rapidly than meat from control animals. (JPRS)

25833 GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BOG. Sturges, David L. (Dept. of Agriculture, Fort Collins, Colo.); Sundin, Robert E. Water Resour. Res., 4: 159-62(Feb. 1968).

Radioassays of water collected between July and October 1965, from four locations at a mountain bog are reported. The gross α and β content of waters was less than 5 and 10 pCi/l, respectively. Gross β activity of filterable solids in ground water collected above the bog reached 400 pCi/g when the water table was at a seasonal minimum, but on other dates and at bog and stream locations, the gross β activity of filterable solids was less than 100 pCi/g. Radiation levels in waters from snow, overland flow, and stream sources were measured in May, June, and October, 1965. Snow water activity was less than 25 pCi/l, but filterable solids had a maximum gross α and β activity of 243 and 1348 pCi/g, respectively. Standing vegetation, litter, and moss on the bog surface screened radionuclides from snowmelt water. Radionuclide filtration on watersheds was significant from a public health standpoint. (BBB)

25834 DIMENSIONS OF THE PROBLEM OF FALLOUT. Terry, Luther L. (Univ. of Pennsylvania, Philadelphia). Pediatrics, 41: Suppl., 170-3(Jan. 1968).

The implications of fallout on public health are discussed. Fallout has a unique position among all health hazards, since no living person in the Western hemisphere and probably very few persons throughout the world have escaped some exposure to this agent. Peacetime fallout is a health problem whose sources confer benefits as well as hazards upon society. Three principal applications of this benefit vs risk equation at the public policy level are considered. The first involves setting standards for acceptable radiation exposures consistent with maintenance of national defense and exploitation of nuclear energy for peacetime purposes. The second would fix standards of potential exposure levels beyond which public health protection action must be taken for uncontrollable emergency situations. The third requires balancing the health gains expected of a given protective measure against the health hazard or economic impact which the measure would create. Responsibilities of official agencies in setting standards governing environmental irradiation of populations deal with very complex problems since very little is known about the effects of small doses of radiation such as natural background radiation and the fallout from nuclear testing. In particular, it is not known definitely whether there is a so-called damage threshold. Determining the relation between radiation exposure and the long-term biological effects of such exposure is complicated further by the fact that these effects are similar to existing diseases which are not radiation caused. (BBB)

25835 DIAGNOSTIC FILM DOSIMETER IN THE STUDY OF RADIATION EXPOSURE TO THE POPULATION RESULTING FROM X-RAY FLUOROSCOPY. Bojtor, Ivan; Bogdany, Barna; Koczkas, Gyula (Frederic Joliot-Curie National Research Inst., for Radiobiology and Radiohygiene, Budapest). Brit. J. Radiol., 41: 147-9(Feb. 1968).

Diagnostic film dosimeter provided satisfactory information about the radiation exposure and scrotal dose of about 2,700 patients subjected to chest fluoroscopy. The survey data offer valuable numerical dosimetry values and at the same time information about dose distribution and fluoroscopic methodology and aperture. (auth)

25836 INTEGRAL DOSE. Mural, Takeo (Tokyo Medical and Dental Univ.). Kokubyo Gakkai Zasshi, 32: 331-47(Dec. 1965). (In Japanese).

The integral dose indicates the total amount of radiation absorbed by the tissues. The unit is expressed by g-R, that is, 87 ergs absorbed by 1 g of tissue. The radiation reaction in the whole body is usually affected by such factors as age, general health, duration of irradiation, and the integral dose, which is one of the most important factors of the whole-body reaction. The integral dose could be measured by calculations from isodose curves, by direct measurement, by calculation from mathematical formula, and by the integral curve method. The isodose curves showed the distribution of radiation in tissues after irradiation with x or γ rays. The isodose curves could be obtained by Mayneord's balance measurement method or by a mechanical integrator. The integral dose could also be obtained by direct measurements of the absorbed radiation in a phantom. Ionization and chemical method are usually used for direct dosimetry. The Meredith and Neary mathematical formulas could be used for the calculation of the integral dose. However, these methods were not

practical and not easily applied in clinical work. Loeffler's modified formula was designed for clinical use, and the integral dose could be measured by the Murai type plastic scintillator phantom method with accuracy and simplicity. (BBB)

25837 CONTAMINATION OF FISH BY RADIOACTIVE CARBON. Fedorova, G. V. (Leningrad State Univ.). Ryb. Khoz., No. 9, 17-19(1965). (In Russian).

Experiments with carp (Cyprinus carpio) in water containing ^{14}C-labeled sodium acetate concentrations of 20 to 24 $\mu Ci/l$ at 18 to 20°C showed that after spending one day in the water the fish become radioactive and that the highest contamination (16.8 to 52.3 $\mu Ci/kg$ raw fish flesh) occurred in the gills, scales, and fins. During the next days the contamination was accompanied by an increase of radioactivity in the internal organs; for a 50 day period, data is presented in tabular form. The radioactivity of the contaminated fish, placed for 30 days in clean freshwater, decreased about 80% in the brains and liver and 60 to 70% in some of the other organs and tissues. Experiments with guppies (Lebistes reticulatus) showed that their contamination at temperatures of 19 to 21°C was 2.5 to 3 times greater than that at 10 to 21°C; the accumulation of radioactivity for 30 days was 121.4 $\mu Ci/kg$ for females and only 72.5 $\mu Ci/kg$ for males. The accumulation coefficient for young guppies was 1.5 to 3 times higher than that for grown guppies. The absorption of ^{14}C by roe and larvae from water was very high. In about one week, the radioactivity of embryos became 2 to 3 times greater than that of the contaminated water. This increase was especially great in larvae fed with chlorella, which also intensively accumulated ^{14}C. The high coefficient of ^{14}C accumulation in larvae made larvae suitable tracers for the determination of water contamination. The ^{14}C entered the fish organisms directly from the water and indirectly from the diet. It was concluded that ^{14}C accumulated in fish organisms in quantities that could be hazardous to life and living processes. (ATD)

25838 RADIATION DOSIMETRY IN PANOREX ROENTGENOGRAPHY. PART III. RADIATION DOSE MEASUREMENTS. Kuba, Ramesh K.; Beck, James O, Jr. (Indiana Univ., Indianapolis). Oral Surg., Oral Med., Oral Pathol., 25: 393-404(Mar. 1968).

The amount of x radiation delivered to selected sites within the head, the skin-entrance air dose, and the scatter and leakage radiation delivered to the male gonads and to the operator during dental radiography were determined with the Average-Man phantom, and ionization chambers. The highest level of radiation was recorded at the center of rotation; the skin lateral to the center of rotation and the parotid gland were next in order. The data obtained during this investigation do not substantiate the claims that by using the panoramic procedures, the patient will receive approximately one-tenth the amount of radiation that he normally would receive from a conventional intraoral full mouth series, and that actual radiation exposure is no greater than the amount involved in taking one intraoral film. The gonadal dose of 0.01 mR is an extremely low figure. The additional protection of the patient's gonadal region with the leaded rubber apron seems to be unnecessary, unless the operator is of the opinion that all ionizing radiations, however small, are potentially dangerous. The radiation dose at the operator's position was 0.03 mR. With a maximum permissible whole-body radiation dose of 100 mR per week for workers with ionizing radiations, more than 3,000 Panorex films can be made in one week without exceeding the recommended limit of safety. (auth)

25839 RADIATION DOSIMETRY IN PANOREX ROENTGENOGRAPHY. PART I. USE OF PHANTOMS IN DENTAL RADIATION DOSIMETRIC RESEARCH. Kuba, Ramesh K.; Beck, James O. Jr. (Indiana Univ., Indianapolis). Oral Surg., Oral Med., Oral Pathol., 25: 380-5(Mar. 1968).

Physical and roentgenographic descriptions of the Average-Man Phantom are reviewed. A search of the dental literature produced no record that this phantom was ever used in dental roentgenologic research. On the basis of experience with this phantom, however, it was concluded that it is a significant tool that could be used profitably in dental roentgenologic research. (auth)

25840 RADIATION DOSIMETRY IN PANOREX ROENTGENOGRAPHY. PART II. PATTERN OF RADIATION DISTRIBUTION. Kuba, Ramesh K.; Beck, James O. Jr. (Indiana Univ., Indianapolis). Oral Surg., Oral Med., Oral Pathol., 25: 386-92(Mar. 1968).

A method of obtaining a roentgenographic record of the actual pattern of x radiation distribution within the head during Panorex roentgenographic examinations of the teeth is described. The roentgenograms produced indicate that the areas of the centers of rotation apparently receive the maximum amount of radiation followed by the areas posterolateral to the rotational centers. (auth)

25841 STATEMENT ON THE RADIATION HAZARD TO FEMALE RADIOGRAPHERS. Radiography, 33: 225-6(Oct. 1967).

A statement prepared by the Radiation Protection Committee of the Council of the British Institute of Radiology relating to reducing hazards to women working in radiology departments was discussed. It was suggested that radiographers in diagnostic departments, other than those whose duties included use of Ra and radioisotopes, would not need to take any additional action in regard to radiation safety in the event of pregnancy, but should, as always, employ good practices, and wear protective aprons whenever indicated, avoid holding children while an exposure was being made, and guard against accidental exposure. The same general recommendations were made for radiographers working in x-ray and γ-ray therapy departments. Radiographers working either diagnostically or therapeutically with Ra and radioisotopes and those whose duties included the radiography of Ra- and radioisotope-heated cases might, in some circumstances, need to have their duties modified in the event of pregnancy. Doses recorded on their film badges or protection dosimeters would indicate to the Protection Officer what steps, if any, needed to be taken. Only if the average monthly surface dose of a pregnant radiographer exceeded 150 mrem and she was using x-ray energies over 100 KV would the question of assessing the fetal dose arise. There would be no need to assess fetal doses in the case of workers with low-voltage diagnostic equipment provided the monthly surface dose did not exceed 400 mrem. (BBB)

25842 MEASUREMENT OF TISSUE DOSES OF COSMIC RADIATION BY NUCLEAR EMULSIONS. Bogomolov, K. S.; Veprik, Ya. M.; Deberdeev, M. Yu.; Kovalev, E. E.; Litvinova, E. G.; Romanovskaya, K. M.; Sirotinskaya, A. A.; Skvortsov, S. S.; Skuredin, V. P.; Smirenniy, L. N. Space Biol. Med. (USSR) (Engl. Transl.), 1: No. 3, 59-65(1963).

Translated from Kosm. Biol. Med., 1, No. 3, 39-43(1967).

Methods for measuring the tissue dose of ionizing radiations with the aid of nuclear emulsions are discussed. Emulsions differing in their sensitivity, with different physical development techniques, were used. Measurements made aboard Kosmos satellites are described. (JPRS)

25843 CHROMATOGRAPHIC TRANSPORT THROUGH SOILS. I. THEORETICAL EVALUATIONS. Frissel, M. J.; Poelstra, P. (Inst. for Atomic Sciences in Agriculture, Wageningen, Netherlands). Plant Soil, 26: 285-302(Apr. 1967).

Mathematical expressions were derived for some models of vertical transport of radionuclides and other ions in soil. Treatment of ^{90}Sr transport by the plate theory was considered. The most important theories that could be used for describing transport through soil were outlined. In using a chromatographic transport theory it was important to select the proper theoretical approach, since when a theory derived for a given situation was applied to a problem related to an entirely different situation, it was impossible to expect reasonable agreement between theory and experiment. The most important question was that concerning the equilibrium situation, i.e., whether there was an equilibrium or not, and if there were no equilibrium, whether a distinct rate-limiting process could be indicated. The DeVault theory, a true equilibrium theory, was scarcely applicable to soils. The Lapidus and Amundson theory and the diffusion theory also assumed equilibrium, and the longitudinal diffusion and dispersion due to finite grain size were taken into account. The latter concept was an attractive pattern for the soil ion transport. When there was definitely no equilibrium, e.g., at high flow rates or with very slow reactions, rate factors could be introduced with the aid of the Hiester and Vermeulen theory. In the absence of a physical model it was better to employ the plate theories, in which a useful parameter, i.e., the plate height, could be introduced without the need for a physical model. The rate theories of Hiester and Vermeulen, as well as the DeVault theory, had the further advantage of being equally applicable to nonlinear absorption isotherms. Special attention was paid to the assumptions that various authors had made to enable a proper choice to be made of a particular theory for a particular case. The relation between the various theories was also stressed. (BBB)

25844 COMPUTER IN RADIOTHERAPY. van de Geijn, J.; Kok, G. Ned. Tijdschr. Geneesk., 110: 1692-5(Sept. 24, 1966). (In Dutch).

Practical and theoretical aspects of the use of computers for more accurate assessment of dose distribution in the irradiated volume, for the protection of healthy tissue and delivery of cancericidal doses to malignant tissue, were considered. Adequate knowledge of the distribution of dose was a prime condition for the accurate treatment of malignant tumors by means of x or γ rays. The usual methods of calculation were of limited value for several

reasons. The information supplied by them was limited to one plane in the patient, and they were too time-consuming. A new theoretical description was developed for the computation of dose distributions produced by high-energy x and γ radiation. A survey was given of the way in which a computer program could be developed and details were given of its present possibilities. Some suggestions for further development were proposed. (BBB)

25845 RESPONSIBILITY OF THE RADIOLOGICAL SAFETY OFFICER. Wilkinson, D. S. (Good Hope General Hospital, Sutton Coldfield, Eng.). Radiography, 33: 231-3(Nov. 1967).

A code of practice outlining the duties of radiological safety officers is presented. The responsibilities of the safety officer as pertains to the staff, equipment, patients, and records is discussed in detail. (BBB) (TSS)

25846 ^{90}Sr AND ^{137}Cs CONCENTRATIONS IN IMPORTED FOODS. II. Kametani, Katsuaki; Ikebuchi, Hideharu. Eisei Shikensho Hokoku, 84: No. 41, 80-1(1966).

Strontium-90 and ^{137}Cs concentrations in imported dry skim milk, soybeans, and wheat were tested. Average concentrations of ^{90}Sr and ^{137}Cs in skim milk (21 samples) and soybeans (6 samples) were 24.0 μμc/100 gram and 66.0 μμc/100 gram, and 12.0 μμc/100 gram and 25.2 μμc/100 gram, respectively. (auth)

25847 DETERMINING LOW-LEVEL ACTIVITIES OF ^{90}Sr IN WHEAT AND ITS DISTRIBUTION IN GRINDING. Vrigazov, Ang.; Marinov, V.; Dimchev, T. (Veterinary Inst. of Contagious and Parasitic Diseases, Sofia). Kernenergie, 11: 23-8(Jan. 1968).

Investigations were carried out in Bulgaria on the contents of low activities of ^{90}Sr in wheat and its distribution in the products obtained by grinding. Samples of wheat, of the 1965 crop, and white flour, ordinary flour, and bran were taken from nine big mills from different regions of the country. The radiochemical method of Bryant was used. The average yield of the Y carrier was 94.4% and the average loss of Sr carrier 32.8%. For measuring the samples an original low background measuring method was worked out with the use of thin plastic scintillators, NE-102, 13.5 mg/cm^2, and 4π geometry at an average background of 2.5 counts/channel. The average value of the contents of ^{90}Sr in wheat for the country was determined at 43.10 ± 6.1 pCi/kg, 50.7 ± 6.1 pCi/kg being for Northern Bulgaria, and 35.5 ± 6.1 for Southern Bulgaria. A balance of the distribution of ^{90}Sr in the products in grinding is given. The results obtained confirm the data given in literature that ^{90}Sr is deposited on the peripheral parts of the grain and that grinding may be considered as a process of decontamination of ^{90}Sr for the products used as food for man. The decontamination depends on the degree of grinding of the grain. (auth)

25848 DOSIMETRIC INVESTIGATIONS ON THE TISSUE EQUIVALENCE OF PHANTOM MATERIALS FOR USE IN ORTHOVOLT X-RAY THERAPY. Kirsch, Manfred; Maier, Bernd; Schumann, Eberhard (Radiologische Klinik und Poliklinik, Erfurt, Ger.). Strahlentherapie, 134: 511-22(Dec. 1967). (In German).

The water equivalence (as criteria for tissue equivalence) was determined for nine different phantom materials for two different radiation qualities used in conventional x ray therapy. Changes in depth dose attenuation and back scattering were determined for 180 kV and 120 kV radiation, using the same conditions, and compared with those obtained with water. The results showed that, for 180 kV radiation Keim's gelatin mixture, a gelatine mixed with cork meal, as well as bee's wax and piacryl, and for 120 kV Keim's gelatin, Siemens wax, and Mix D, can be used for phantoms. Instructions for preparing the phantom materials are given. (auth)

25849 ^{137}Cs BODY BURDENS IN MAN: JANUARY 1956 TO DECEMBER 1966. Richmond, C. R.; Furchner, J. E. (Univ. of California, Los Alamos). Radiat. Res., 32: 538-49(1967).

Body burdens of ^{137}Cs originating from nuclear weapons fallout were measured in a group of New Mexico subjects by whole-body counting for the period January 1956 to January 1967. Body burdens ranged from 4.5 nanocuries (nCi) during the first quarter of 1956 to 14.0 nCi during the third quarter of 1964. During the third quarter of 1966, burdens were about 6.0 nCi. The radiation dose ranged from 0.09 mrem for the third quarter of 1961 to 0.40 mrem for the third quarter of 1964. The total integrated radiation dose for the 11-year period was 9.3 mrems, or about 6% of that resulting from body ^{40}K. Cesium-137 concentrations agree with those reported from other Northern Hemisphere laboratories until after the 1961 and 1962 test series; since then, concentrations appear to increase with latitude in the Northern Hemisphere, presumably as a result of intensive testing at high latitudes by the USSR. A model that describes retention of fallout ^{137}Cs in a population is presented. (auth)

25850 DATA. Radiol. Health Data Rep., 7: 445-84(Aug. 1966).

Data are presented on the following surveillance activities; the ^{90}Sr, ^{89}Sr, and ^{137}Cs content of milk in North America and Pan America during April, 1966, according to national and international surveillance stations, the ^{89}Sr, ^{90}Sr, ^{40}K, ^{131}I, and ^{137}Cs content of milk during Jan. to March, 1966 is reported by the Connecticut, Indiana, Minnesota, and Pennsylvania surveillance stations, the radioisotope content of teenage diets during Feb. to Nov. 1965 in the United States is reported, gross radioactivity content of the surface waters of the United States is reported for Feb., 1966, the radioactivity content of airborne particulates and precipitation in North America is reported for April, 1966, the environmental content of radioactivity at the Pinellas Pennisula Plant and the Savannah River Plant are given for July to Dec., 1965, and the ^{238}Pu, ^{239}Pu, and ^{240}Pu content of airborne particulates in the United States during Nov., 1965 to March, 1966 is reported. The Atomic Energy Commission reports one underground nuclear test at its Nevada Test Site during July 1966, and France reports 2 atmospheric nuclear tests over Moruroa during July 1966. (E.R.B.)

25851 ALTERED WOUND HEALING IN X-IRRADIATED RATS: THE EFFECT OF BONE MARROW SHIELDING. Stromberg, Lw. R.; Woodward, K. T.; Mahin, D. T.; Donati, R. M. (Walter Reed Army Inst. of Research, Washington, D. C.). Experientia, 23: 1064-5(Dec. 15, 1967).

Female rats, 10 to 12 weeks of age, were given a single whole-body radiation of 800 R. The rats were immobilized by tying their hind limbs together and placing them in lead cylinders so that both the hind limbs and the pelvis were shielded. Unshielded animals were treated in a similar manner without utilizing the lead cylinders. One group of animals was sham irradiated, one group was whole-body irradiated, and the third group was irradiated following bone marrow shielding. From each group, one half of the animals were wounded by excising dorsal skin on the fourth day following irradiation. Dimensions of the wound were recorded at the time of wounding and every two days thereafter. Thirty day mortality was also recorded. Bone marrow shielding was associated with a significant diminution in mortality in both wounded and non-wounded animals. The rates of wound contracture show that the shielded animals had an initial delay similar to that shown by the non-shielded animals when compared with the sham irradiated controls. However, the subsequent rate of contracture of their wounds was quite rapid. (H.L.W.)

25852 ^{90}Sr CONCENTRATIONS OBSERVED IN U.S. PASTEURIZED MILK COMPARED WITH ^{90}Sr LEVELS IN PRECIPITATION, IN TOTAL DEPOSITION, AND IN SOIL, 1960–1963. Fisher, Henry L.; Coleman, James R.; Grundy, Richard D. (Public Health Service, Washington, D. C.). Radiol. Health Data Rep., 7: 427-39(Aug. 1966).

Annual averages of the ^{90}Sr content of milk were compared with precipitation ^{90}Sr deposition, and ^{90}Sr in soil for the years 1960 to 1963 on the basis of linear relationship. This relationship may be useful for limited predictions of future ^{90}Sr concentrations in milk. As expected, higher concentrations of ^{90}Sr were found in milk from areas of higher concentrations of ^{90}Sr in soil, and higher milk concentrations seemed to be associated with increased rainfall. Although it was clear that increased deposition of ^{90}Sr was related to its concentration in milk, variations in the relationship remain to be studied on the basis of the specific transport mechanisms involved. (auth)

25853 ^{222}Rn IN NATURAL GAS. Bunce, Louis A. (Public Health Service , Farmington, N. Mex.); Sattler, Frank W. Radiol. Health Data Rep., 7: 441-4(Aug. 1966).

In the preoperational phase of a study to determine the effect of an underground nuclear detonation on radon content of natural gas, baseline levels of ^{222}Rn were measured during 1965 in natural gas from 307 producing wells in the proposed test area. Average ^{222}Rn levels in natural gas from formations sampled varied from 2.7 to 66.9 pCi/liter, with a maximum observed value of 158.8 pCi/liter. Assuming combustion in a room without discrete ventilation, ^{222}Rn buildup from an original fuel concentration of 50 pCi/liter could produce a room concentration of 1 pCi/liter in the New Mexico area where the gas would be used. This estimated concentration equals the maximum exposure level permitted by regulations of the State of New Mexico (based on NCRP limits) under conditions on continuous or general population exposure. Normal use of natural gas would not be expected to produce ^{222}Rn concentrations in excess of these recommended limits. (auth)

25854 RESPONSE OF DOUBLE-HEAD AND SINGLE-HEAD COLLIMATORS FOR SCANNING. Popovic, S. (Univ. of Zagreb); Fowler, J. F. Int. J. Appl. Radiat. Isotop., 19: 313-25(Apr. 1968).

Collimator parameters are discussed in regard to poor dependence of sensitivity on depth. Large diameter crystal detectors are shown to be poor in this respect. Two collimators facing each other are shown to be better than a single long-focussing collimator of the same total detector area. (auth)

25855 TABLES FOR CALCULATION OF THE ABSORBED DOSAGE IN CURIETHERAPY OF CANCER OF THE UTERUS. Kholin, V. V.; Lukyanov, V. P. (State Post-Graduate Medical Inst., Leningrad). Vop. Onkol., 13: No. 6, 112-18(1967). (In Russian).

New modified tables for calculation of the absorbed dose in rads in radiotherapy of the cervix uteri cancer are suggested. With the aid of tables presented in the paper it is possible relatively promptly and easily to calculate the absorbed dose for any kind of application of linear preparations of radioactive cobalt in the vagina, cervical canal and uterine body. (auth)

25856 RADIOLOGICAL PROTECTION IN UNIVERSITIES. London, Association of Commonwealth Universities, 1966. 39p. 3s. 6d.

Handbook to supplement "Code of Practice for Protection of Persons Exposed to Ionising Radiations in Research and Teaching" and "Code of Practice for Protection of Persons against Ionising Radiations arising from Medical and Dental Use." Main headings are as follows: Legal requirements; administrative organisation; personnel supervision; radiation and contamination hazards; particle accelerators and nuclear reactors; storage and transport of radioisotopes; disposal of radioactive waste; methods of monitoring; emergency procedures; training and education. An extensive bibliography is included. (UK)

25857 STANDARDS OF PERFORMANCE FOR FILM BADGE SERVICES. Barber, Donald E. Environmental Health Series–Radiological Health. Washington, D. C., Public Health Service, 1966. 47p. (PHS–999-RH-20). GPO Free.

A quality control program self-imposed by film badge services is described. Film badge performance evaluation procedures have been devised to generate data sufficiently broad in scope to serve as the basis for control limits. The evaluation procedures and control limits will be applied in periodic examinations of film badge services. Irradiation procedures, dosimetry, and a measure of film badge accuracy appropriate to the practical use of film badges are discussed. Approximately 2,000 film badges were irradiated with various types and energies of radiation. Exposures ranged from 0.002 to 497 roentgens. Film badge services helped design the test procedures, submitted badges for exposure, interpreted exposures, and assisted in determining provisional performance control limits. All services were informed of the test procedures to be used in the test. However, the services did not know which badges were exposed to what type, energy, or dose of radiation. A measure of accuracy, called an error factor, was determined for each service for each type and energy of radiation in the test. These error factors are tabulated to show the accuracy of the film badge services tested. Administrative procedures for periodically evaluating film badge service performance and for recognizing acceptable performance are also described. (auth)

25858 ROUTINE SURVEILLANCE OF RADIOACTIVITY AROUND NUCLEAR FACILITIES. Interlaboratory Technical Advisory Committee Report No. 1. Environmental Health Series–Radiological Health. Washington, D. C., Public Health Service, 1966. 28p. (PHS–999-RH-23). GPO $0.25.

A concise, comprehensive, and practical guide for planning, operating, and evaluating the effectiveness of a program for routine surveillance of radioactivity around nuclear facilities is presented. Included are references to regulations and guides for evaluating releases from such facilities, and commentary on the nature and types of wastes to be anticipated; their fate when released to the environment; and recommended procedures for sampling the air, water, milk, food, biota, soil, and people for resulting contamination. (auth)

Medicine

Refer also to abstracts 25255, 25636, 25658, 25714, 25721, 25737, 25796, 25806, 25807, 25811, 25821, 25844, 25912, 25920, 26004, and 27465.

25859 (UCLA–12-668, pp 1-28) NUCLEAR MEDICINE. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

LUNGS—scanning for determination of regional pulmonary ventilation and bronchial patency
LIVER—scanning in hepatobiliary disease
URANIUM 235—content of industrial personnel, determination of
IRON—sorption of dietary, in man, use of iron-59 and whole-body counting to determine
KIDNEYS—scanning of human, using technetium-99
PHARMACEUTICALS—radioactive, for kidney scanning, evaluation of short-lived
BRAIN—assessment of blood circulation in, using magnacamera; radioisotope uptake by tumors of, in tissue culture
MAN—dynamics of cerebral circulation in, use of iodine-131 or technetium-99-labeled albumin and cine scintiphotography to determine
TRANSPLANTS—survival following antibody suppression with radioiodinated antigens
MICE—recovery of lymphoid tissues and immunologic competence in irradiated, neonatally thymectomized

25860 (UCLA–12-668, pp 29-36) BIOPHYSICS. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

RADIOISOTOPE SCANNERS—development of high-speed section
BLOOD—determination of biophysical characteristics of fractions of; separation of erythrocytes and lymphocytes from whole, by equilibrium centrifugation techniques
NUCLEAR EMULSIONS—scanning proton-recoil tracks in, determination of sampling biases of
BERYLLIUM—neutron emission by, spectra of (H.L.W.)

25861 (JPRS–39391) PROBLEMS OF RADIATION SICKNESS PROPHYLAXIS AND TREATMENT. Zamfir, C.; Herscovici, H.; Cioba, Gh.; Andronie, C. Translated from Rev. Sanit. Mil., No. 6, 939-48(1966). 14p. (TT–67-30042). CFSTI.

Problems associated with protection against and treatment of radiation sickness are discussed. Consideration is given to practical application of research results in the event of nuclear attack, i.e. physical measurement of actual radiation dose; RBE; laboratory tests for radioinduced changes in the natural and acquired immunity of an organism; environmental and physiological factor affecting radiosensitivity; use of radioprotective drugs (cysteamine, mercaptopropylamine, AET, cystamine, and serotonin); and complex principles and methods of treating radiation sickness: combating infection by use of antibiotics and bone marrow transplants, anti-allergic, antitoxic, and neuropsychic treatment; treatment of digestive syndrome; and dietary treatment. Methods associated with elimination of radioisotopes from the body are also discussed. The five references are cited. (B.S.L.)

25862 TUMOR INHIBITING EFFECT OF IRRADIATED BONE MARROW SUSPENSION. Czeizel, Endre; Vaczo, Gyoergy; Kertai, Pal Magy. Onkol., 9: 21-5(1965). (In Hungarian).

The growth of Yoshida sarcoma and Guérin carcinoma was inhibited by irradiated bone marrow suspensions in rats. After stopping treatment, the period of survival of treated animals almost coincided with the survival of non-treated control animals. The direct anticancerogenic effects of the x ray may thus be complemented by the toxic substances produced by the irradiated tissues. (auth)

25863 INFLUENCE OF CERTAIN COMPOUNDS ON RADIOSENSITIVITY OF ANIMALS. Piskov, V. B.; Orlova, L. V.; Tarasova, K. Ya.; Klimova, S. P.; Rodionov, V. M. (Inst. of Biological and Medical Chemistry, Moscow). pp 248-53 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The influence of 1-oximepyruvaldehyde, 3-piperidinopropiophenone and its combination with morphine, thiocite (a mixture of $NaNO_3$ and $Na_2S_2O_4$), Rongalit, and the sodium salt of [(carboxymethyl)thio] succinic acid, salsoline, glucan, and atabrine on the radiosensitivity of black male C57 mice and white rats was investigated. The mice weighed 18 to 23 g and the rats weighed 170 to 190 g. The mice were irradiated at a dose of 650 to 750 R and the rats were irradiated at a dose of 700 to 800 R; the dose rate was 56R/minute. A small but well-defined protective effect was detected upon administration of 100 to 200 mg of salsoline per kg of body weight ten minutes before irradiation. (JPRS) (TSS)

25864 RADIOPROTECTIVE ACTION OF STELLIN. Romantsev, E. F.; Tikhomirova, M. V.; Kaverzneva, E. D.; Gordienko, S. V. pp 244-8 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The protamine, stellin, isolated from the milt of the sturgeon Acipenser stellatus, was injected into mice intraperitoneally 10 min before whole-body irradiation with ^{60}Co γ rays. The total

dose was 750 R, irradiation time was 104 sec, the dose was 432 R/min. The sulfate, hydrochloride, and ascorbinate of stellin were used. It was found that all three salts of stellin had a statistically significant radioprotective effect; the greatest protective effect was obtained with stellin sulfate. In another series of experiments in which the salts of stellin were injected together with 1-cysteine it was found that the addition of 1-cysteine to stellin markedly increased its radioprotective action. (ATD)

25865 MECHANISM OF SPONTANEOUS POSTRADIATION REPAIR OF CHROMOSOMES AND THE PROTECTIVE ACTION OF CYSTEINE. Tsarapkin, L. S. pp 134-42 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Dormant air-dried pea seeds irradiated with ^{60}Co γ rays at a dose of 15,000 R at a rate of about 30 R/min were used. From two to four days after irradiation the seeds were soaked for 4 to 6 hr in 0.01 molar neutral solution of cysteine and then for another 18 to 20 hr in water. The cytogenetic effect observed in the experiment was composed of two factors, namely a primary lesion and two processes of reparation and independent (local) and cellular repair. The spontaneous process of the recovery of cells from potential chromosomal lesions was accomplished by both mechanisms during the first postradiation mitosis, but the primary role was played by cellular repair. The protective action of cysteine used after irradiation was demonstrated by acceleration of spontaneous cellular repair. The probability of the recovery of cells from potential chromosomal lesions was found to depend on the degree of damage to the entire protoplast. (ATD)

25866 THE IRREVERSIBLE COMPONENT OF RADIATION INJURY OF YEAST CELLS. I. THE ROLE OF CELL METABOLISM IN THE DEVELOPMENT OF RADIATION INJURY. Karabaev, E. M.; Kholeva, S. Ya. (Inst. of Medical Radiology, Obninsk, USSR). pp 56-9 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Three-day cultures of diploid yeasts (Saccharomyces vini in an aqueous suspension were x-irradiated at a dose of 36.7 kR at a dose rate of 20 kR/minute. Two days later, when possible recovery was completed and the recovery curves was on a plateau, some cells were put into 0.5% glycose solution and some were irradiated with a dose that reduced the survival to the original rate of 5%. Both suspensions were allowed to recover for three to five days. The glucose had no influence on the plateau level. Cells irradiated two and three times recovered just as successfully after reaching the plateau as those irradiated only once; however, the irreversible component was increased and the plateau level lowered by the effect of the radiation. (JPRS)

25867 USE OF THE METHOD OF MEASURING THE REDOX POTENTIAL IN ANIMAL TISSUES WHEN SELECTING EFFECTIVE RADIOPROTECTORS FOR MICE IRRADIATED BY HIGH-ENERGY PROTONS (660-MeV). Konoplyanikov, A. G.; Kudryashov, Yu. B.; Mekhtieva, S. M. pp 177-82 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The dependence between the magnitude of drop of the redox potential after injecting animals with various protectors and the effect of protection against high-energy proton irradiation was studied. The mice were irradiated with 660-MeV protons at doses of 980 and 1350 rad at a rate of 200 rad/min. Twenty-four radioprotective compounds were used before and after irradiation. The investigation demonstrated that the effectiveness of mixtures of radioprotectives and of most of them used alone correlated well with the magnitude of drop of the redox potential in mouse muscles. It was concluded that the method of measuring the redox potential in animal tissues could be used for studying the properties and for preliminary selection of effective radioprotectors to guard animals against the action of high-energy particles. (ATD)

25868 INVESTIGATION IN VITRO OF THE MECHANISM OF ACTION OF CHEMICAL PROTECTORS: PREVENTION OF THE DAMAGING EFFECT OF OXYGEN. Ganassi, E. E.; Eidus, L. Kh.; Arifulina, R. A. pp 171-7 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The hypothesis that the protective effect of various agents was due to a weakening of the modifying action of oxygen in radiation damage was examined. Solutions of myosin that were known to have both an oxygen effect and an oxygen aftereffect were used. The myosin solutions were γ-irradiated at a dose rate of 500 to 700 R/min. For protectors β-alanine and sodium nembutal were used. Experiments confirmed the hypothesis that the previously detected mechanism of concentration blocking was caused by the prevention of the damaging effect of oxygen on macromolecules with latent damages. The addition of the protector after irradiation prevented the oxygen aftereffect since in this case the oxygen was ineffective. However, the protection was temporary and after a time damage occurred. (ATD)

25869 MECHANISM OF THE OXYGEN EFFECT. Sumarukov, G. V. (Moscow State Unvi.). pp 163-70 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Male field crickets (Grillus domesticus L.) seven to ten days old received 3420 to 13,500 R at 270 or 1380 R/minute in early anaerobiosis (after one minute) and late anaerobiosis (after 20 minutes) and were placed at once in an atmosphere of air. Radiosensitivity was determined on the basis of survival on the 25th day, length of life or the radioeffective dose (that causing a 10-day average length of life), and was found to depend on the decrease of Eh in the tissues in both the early and late periods of anaerobiosis. In an atmosphere with a low oxygen content, radiosensitivity had little relation to the change of the oxygen pressure in the tissues. Oxygen effect, if regarded from the point of view of the role of oxygen only in primary radiochemical reactions, was a partial manifestation of a more general oxidative-reductive radiobiological effect. (JPRS)

25870 THE IRREVERSIBLE COMPONENT OF RADIATION INJURY OF YEAST CELLS. II. ON WHETHER IT RESULTS FROM CELLS INCAPABLE OF RECOVERY OR FROM IRREVERSIBLE ELEMENTARY INJURIES. Kapul'tsevich, Yu. G. (Inst. of Medical Radiology, Obninsk, USSR). pp 60-7 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Yeast cells, Saccharomyses cereviseae, strain 16 × 32 (tetraploid) and X362 (diploid) and Saccharomyces vini, strain Megri 139B (diploid) were irradiated with Co-60 γ rays at a dose of 240 kR that reduced survival to 1.8%. The irreversible component of radiation injury was found to be the result of irreversible elementary injuries; no individual cells incapable of recovery were detected. (JPRS)

25871 INTERCHANGEABILITY OF PROCESSES OF RESPIRATION AND FERMENTATION IN THE POSTIRRADIATION RECOVERY OF YEAST ORGANISMS. Mosin, A. F.; Ivanova, R. P. (Inst. of Medical Radiology, Obninsk, USSR). pp 68-73 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

A three-day culture of Saccharomyces vini, strain Megri-139B, cultivated in wort-agar, was γ-irradiated (^{60}Co) in aqueous solution and an initial survival of 2 to 3% was obtained. The cells were then kept 24 hours at 30°C under aerobic and anaerobic conditions at various dilutions with and without glucose. Recovery was determined quantitatively. In the absence of oxygen, fermentation provided the same level of recovery as did respiration if the glucose content in the suspension was not less than 3.3 $\mu g/10^4$ cells (to provide the fermentation substrate) and the density of the suspension did not exceed 1 to 3×10^7 cells/ml; a larger density led to an overaccumulation of alcohol. (JPRS)

25872 DEPENDENCE OF POSTIRRADIATION RECOVERY OF YEAST CELLS ON THEIR PLOIDY. Kabakova, N. M. (Inst. of Medical Radiology, Obninsk, USSR). pp 84-90 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Sterile top-water suspensions of Saccharomyces cereviseae with one to six sets of chromosomes (UO2587, X320, X321, X323 and X362) (1×10^8 to 5×10^8 cells/ml) were x-irradiated at various doses at a dose rate of 20 kR/min and then incubated for 48 hours at 30°C. Survival was determined after irradiation and during incubation. All strains with a ploidy of two to six were capable of recovery; the rate of recovery did not depend on the degree of ploidy. The irreversible component of injury decreased somewhat with increase of ploidy but the decrease was of such a type that it tended to indicate incomplete reversibility of injuries that caused dominant lethal mutations. (JPRS)

25873 THE NATURE OF POSTIRRADIATION RECOVERY. II. THE RECOVERY OF E. COLI B IRRADIATED BY α-PARTICLES IN AIR AND IN NITROGEN. Val'dshtein, E. A.; Zhestyanikov, V. D.; Paribok, V. P. (Inst. of Cytology, Leningrad). pp 25-31 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeni-

yakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Escherichia coli B were irradiated with α particles and x rays and cultivated at 19, 37 and 45°C on a complete medium and at 37°C on a minimal medium. There was little or no recovery after irradiation by α particles in air. After irradiation in nitrogen, recovery was much higher but not as high as after x irradiation. The lower rate of recovery after α irradiation was explained by severe (less reversible) injury to the reproductive system. (JPRS)

25874 THE NATURE OF POSTIRRADIATION RECOVERY. III. THE RECOVERY OF RADIORESISTANT MUTANTS OF E. COLI B IRRADIATED IN AIR AND IN NITROGEN. Zhestyanikov, V. D.; Paribok, V. P.; Val'dshtein, E. A. (Inst. of Cytology, Leningrad). pp 31-40 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Escherichia coli B and three radioresistant strains (B/r, Bγr and B/rγR) were irradiated with α particles and x rays and incubated at 19, 37 and 45° on complete and minimal media and also on nutrient agar prepared from fish-bone meal. The number of macrocolonies formed was the criterion for survival. Variation of the postirradiation medium and temperature considerably increased the survival of E. coli B but had little influence on that of the radioresistant strains because of their ability to repair damage under all the test conditions. (JPRS)

25875 TEST OF AMINE AND THIOL RADIOPROTECTORS IN γ IRRADIATION OF BACTERIA. Semenov, L. F.; Stasilevich, Z. K. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). pp 46-50 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The radioprotective effectiveness of thiols (MEA, cystamine, AET, and hyposulfite) and amines (adrenalin, phenylethylamine, histamine, mexamine and acetylcholine) was compared using Escherichia coli 675 that was irradiated at doses of 60 to 100 kR at 75 to 80 R/minute. Thiols were found to protect E. coli against the effects of radiation; substances containing a free sulfhydryl group were the most effective. No parallelism was found between the protective action of thiols on E. coli and mammals. Amine preparations had no protective effects on E. coli. (JPRS)

25876 PHYSICOCHEMICAL AND BIOLOGICAL STUDIES ON SOME NEW RADIOPROTECTIVE SUBSTANCES SYNTHESIZED FROM PETROLEUM WASTE PRODUCTS. Gasanov, G. I. Izv. Akad. Nauk Azerb. SSR, Ser. Biol. Nauk, No. 3, 110-15(1966). (In Russian).

The radioprotective properties of five quaternary ammonium salts were appraised from: change in the oxidation-reduction potential; oxidation of β-carotene; results of chemoluminescence; and tests on rats. Only one of the five substances proved to be effective by the above criteria. Twenty-six of 60 rats (45%) irradiated with a dose of 700 R after receiving injections of 25 mg/kg of the substance were alive after 30 days as compared with 25 rats injected with cysteamine and only two control animals. The results were considered to be sufficiently encouraging to justify further investigation of chemical compounds derived from petroleum products as possible radioprotective agents. (JPRS)

25877 URETHAN AND LEUKEMOGENESIS. Vesselinovitch, S. D. (Chicago Medical School Inst. for Medical Research). Cancer, Bull., Tex. Ed., 19: 74-5(July-Aug. 1967).

The coleukomogenic effect of urethan, particularly in synergism with ionizing radiations, is reviewed. It was first reported that urethan, although not causing leukemia by itself, augmented leukemogenesis in mice when given concurrently with any of the following inducers of leukemia: x rays, estrogenic hormones, or methylcholanthrene. It was also demonstrated that urethan enhanced x-ray leukemogenesis when given after x irradiation, but not before. Shortly after this discovery, it was shown that urethan, by itself, could induce leukemia when administered either once to newborn Swiss mice or repeatedly to C57BL mice, but not in adult mice. It was suggested that thymic injury followed by a sustained period of thymus impairment, along with the appearance of immature cells, was an essential prerequisite for lymphoma development by x irradiation. Thymic regeneration and lymphoid cell maturation proceeded more rapidly when the bone marrow was shielded during irradiation, so that a large number of the immature cells were only briefly present. Under these conditions, the leukemogenic effect of x irradiation was significantly less. Thus, both thymic and bone marrow injuries were essential for the protracted presence of immature lymphoid cells and the consequently successful leukemogenesis by x irradiation. Therefore, it was likely that a necessary condition for successful leukemogenesis by virus, x rays, or chemicals was the presence of immature, multiplying cells in the thymus at the time of the action of the carcinogen. While the mice during their first two weeks of life were physiologically characterized by such a cell population, adult mice could have this condition recreated by whole-body irradiation. Apparently, repeated and periodic treatments with urethan from the newborn through the infant age were leukemogenic because of the concurrent existence of the immature cell population in the thymic cortex. The failure of prior urethan injections to synergize irradiation suggested that urethan lacked the capacity to inject (release endogenous) virus in adult mice, whereas its leukemogenicity in newborn mice indicated that at this age urethan could elicit the same triad of effects (virus release, thymic injury, and bone marrow injury) as irradiation. (BBB)

25878 RADIOPROTECTANTS AND RADIOTHERAPY OF CANCERS. Maisin, J. R.; Mattelin, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Bull. Cancer, 54: 149-58 (Apr.-June 1967). (In French).

The ability of some radioprotective agents to penetrate tumors and their effectiveness in radiotherapy are reviewed, and some experiments are reported on their use in mice. Various agents were tested in BALB/c^{+} mice injected with Landschuetz cells and exposed to different radiotherapy fractionation regimens. Simultaneous administration of one or more sulfhydryl compounds, such as 2-β-aminoethylisothiourea (AET) together with substances which produce anoxia, for example, 5-hydroxytryptamine (5-HT), rendered better protection against acute lethality after whole-body x irradiation than treatment with any of these substances alone. It was also shown that addition of glutathione or cysteine further increased the protection offered by AET and 5-HT while at the same time diminishing the toxicity of the protective mixture. Although AET penetrated also into cancer tissues and protected them against radiation damage, it could be demonstrated that, under certain conditions, a mixture of chemical protectors was even more beneficial in the x-ray treatment of experimental tumors. It was emphasized that more experiments had to be carried out, however, to determine especially whether similar results could be obtained when the field of irradiation was smaller and the dose lower. Moreover, such studies should indicate whether a selective protection for normal vs cancerous tissues existed after treatment with such protective mixtures and whether more advanced cancer could also be treated to advantage in the same manner. (BBB)

25879 HISTOLOGICAL APPEARANCE OF LYMPH NODES OF RABBITS AFTER THYMECTOMY OR APPENDECTOMY AT BIRTH FOLLOWED BY X IRRADIATION AND INJECTION OF ANTIGENS. Hanaoka, Masao; Konda, Susumu; Takiguchi, Tomoo (Kyoto Univ.). Nippon Ketsueki Gakkai Zasshi, 30: 69-80(Feb. 1967).

Histologic changes in the lymph nodes were compared in rabbits after appendectomy or thymectomy, followed by x irradiation and antigen injection. The cortex of the lymph nodes comprised three parts: marginal islets of small lymphocytes, including primary nodules; the lymphoid matrix; and the area around the postcapillary veins. Following appendectomy and irradiation, lymphocytes were reduced in number in the lymphoid matrix of the cortex and medullary cords, but not in the marginal lymphocytic islets or around the postcapillary veins. The reticulolymphocytic system, composed mainly of lymphogonia and large basophilic lymphocytes, decreased its reactivity against antigens in the appendectomized and irradiated group, and the germinal centers were either unrecognizable or atrophic. On the other hand, in thymectomized irradiated rabbits, medium-sized and small lymphocytes were almost completely absent in the lymph nodes, especially around the postcapillary venules. The germinal centers were well developed in size and number, and the reticulolymphocytic system was able to proliferate after the injection of antigens. It was concluded that lymphocytes could be divided into at least two groups; cells of reticulolymphocytic system and faintly or nonbasophilic small or medium-sized lymphocytes. (BBB)

25880 METOKLOPRAMID AS AN ANTIEMETIC IN THE PRIMARY, GENERAL IRRADIATION REACTION OF EXPERIMENTAL ANIMALS. Santha, Andras. Honvedorvos, 18: 313-21(Oct.-Dec. 1966). (In Hungarian).

The effect of metoclopramide on the motility of the digestive tract and its antiemetic effect were studied in animal experiments. The compound was an antiemetic with low toxicity and a broad range of effectiveness which had a beneficial influence on the motility of the digestive tract. In addition to the alleviation of the emetic component of primary irradiation reaction, the drug suspended the gastric retention that accompanied irradiation

and it increased the rate of intestinal passage. It also enhanced the movement of intestinal villi, thereby facilitating resorption. The drug decreased the readiness of the intestinal wall toward antiperistalsis, as one of the mechanisms of its local action. This was a preganglionary effect and did not inhibit the effect of phenothiazines and ganglion blockers. In therapeutic doses, the drug normalized the spontaneous or drug-induced hypermotility of irradiated mice. In large doses, it acted as a tranquilizer. Metoclopramide increased the physical ability of irradiated mice as measured by the swim test; its effect was a function of the radiation and drug doses. As a preliminary conclusion, the acceptance of metoclopramide among the drugs used in primary, general radiation sickness was recommended. (JPRS)

25881 INFLUENCE OF THE DOSE AND FRACTIONATION ON THE SURVIVAL OF A GROUP OF LARYNGEAL CANCER PATIENTS TREATED BY TELECOBALT THERAPY. Clement, R.; Amalric, R.; Santamaria, F.; d'Istria, J. Colonna. J. Radiol., Electrol., Med. Nucl., 45: 859-60(Dec, 1964). (In French).

A study was made of 88 patients with cancer of the larynx in all stages to determine the influence of dose and of treatment schedule on the survival for two yrs. Irradiation times of six to ten weeks were used for the 61 patients all of whom survived for at least two yrs. It was found that the survival rate decreased as the length of treatment increased. However, the total doses, that ranged from 5000 to 8000 R, produced varying effects. The most effective results being obtained from doses between 7000 and 7900 R. Another study was made of only stages I and II of laryngeal cancer, which included 18 out of 26 survivors for a two yr. period. A short treatment time here also proved to be the most beneficial and doses from 6000 to 6900 R the most effective against earlier stages of the cancer. (BBB)

25882 EFFECT OF THE PRELIMINARY USE OF INDOLYL ALKYLAMINES AND CYSTAMINE ON TOXICITY AND VASODILATIVE AND RADIOPROTECTIVE ACTION OF 5-METHOXYTRYPTAMINE. Zherebchenko, P. G.; Zaitseva, T. G.; Tank, L. I. pp 235-44 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

In experiments carried out on white mice exposed to whole-body x radiation at a dose of 700 R it was found that the repeated injection of 5-methoxytryptamine (5-MOT) was accompanied by an appreciable decrease in its toxicity. This effect was absent when 5-MOT was injected into the animals after 6-methoxytryptamine. The preliminary use of tryptamine derivatives having substituents in the fifth position of the indole ring lowered the vasodilative action of 5-MOT. This attenuation of the reaction was less evidenced after preliminary injection of the animals with indolyl alkylamines with a different position of the substituting group. The preliminary use of cystamine lowered the toxicity and vasodilative action of 5-MOT. The radioprotective action of 5-MOT was substantially lowered if this amine was repeatedly injected into the mice at 4 hr intervals or at some time interval after cystamine. Under the same experimental conditions, 6-MOT did not affect the radioprotective activity of 5-MOT. The radioprotective activity of cystamine decreased only slightly during the aftereffects caused by the use of 5-MOT. (ATD)

25883 INVESTIGATION OF THE RADIOPROTECTIVE ACTION OF SEROTONIN BASED ON CYTOLOGICAL DATA. Pukhal'skaya, E. Ch. pp 229-35 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

A review and comparison of data on conditions required for the radioprotective action of serotonin with data on either its cytostatic effect or its effect of activating cell proliferation of various tissues gave grounds for the suggestion that serotonin had a biphasic action in radioprotection. The cytostatic effect consisted of reversible blocking of some portions of the cell cycle. The proliferative phase was associated with the action of serotonin metabolites on tissues of various organs that enhanced cell proliferation in them. Research results have shown that both phases of action of serotonin could be reproduced separately in various objects of cell proliferation. This offered the prospect for the successful use of these effects of serotonin not only for radioprotection but also for therapy of hypoplastic states of certain organs, in particular, bone marrow. (ATD)

25884 MECHANISM OF ACTION OF RADIOPROTECTORS MEXAMINE AND β-MERCAPTOETHYLAMINE. Strelkov, R. B.; Kosichenko, L. P. pp 222-9 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian)

The corneal epithelium of white mice was the object of a comparative study of certain aspects of the mechanism of action of the most effective radioprotectors, mexamine (5-methoxytryptamine) and β-mercaptoethylamine. In one series of experiments the radioprotectors were injected into the conjunctival sac 30 min before irradiation in maximum tolerable concentrations. In a second experimental series the investigated preparations were injected subcutaneously. The β-mercaptoethylamine, acting locally on the corneal epithelium, exhibited protective properties during total-body irradiation of the animals (100 R), whereas mexamine under identical conditions was ineffective. Mexamine injected parenterally protected the processes of cell multiplication of the cornea against the damaging effect of ionizing radiation. Under the same experimental conditions β-mercaptoethylamine did not render a protective action. The mechanism of action of the sulfur-containing preparation β-mercaptoethylamine and of the indole derivative, mexamine, substantially differed and required further study. (ATD)

25885 EFFECT OF AET ON REPARATION PROCESSES DURING DIFFERENT DOSES OF IRRADIATION. Antipenko, E. N.; Berlin, L. B. pp 214-22 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Data on the effect of aminoethylisothiuronium bromide hydrobromide (AET) on hematopoiesis and regenerative processes in the duodenal epithelium of rats was presented. The effect obtained with nonlethal irradiation was compared with the results of experiments with the lethal effect of radiation. It was found that the radioprotective action of AET on reparative processes in bone marrow and the duodenal epithelium of rats varied for different doses of ionizing radiation (700, 350, and 100 R). As the dose of irradiation decreased, the protective effect of AET decreased; however at a dose of 100 R, AET still promoted an accelerated maturation and release of granulocytes and also stimulated the formation of monocytes. One area for further investigation of the efficacy of radioprotectors in nonlethal irradiation should be a determination of the quantitative aspect of protection of radiosensitive cells. (ATD)

25886 EFFECT OF CYSTAMINE ON THE PHAGOCYTIC ACTIVITY OF RABBIT BLOOD LEUKOCYTES. Akimov, P. A. pp 212-13 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Two series of experiments were conducted. In the first series cystamine was tested in vitro in concentrations of 1.0 to 0.0078125% in a 2% solution of sodium citrate. Phagocytosis of the leukocytes was determined with respect to a one-day-old culture of Staphylococcus 209. In the second series of experiments cystamine was injected once intravenously into rabbits in a dose of 50 mg/kg. The results of the first experiment showed that under the effect of the test concentration of cystamine the number of active leukocytes did not change but their phagocytic activity increased. In the second series the injection of cystamine in a dose of 50 mg/kg also stimulated the phagocytic activity of the rabbit leukocytes. (JPRS)

25887 RADIATION DAMAGE OF LYMPHOCYTES AND ITS CHANGE WHEN CYSTEAMINE IS USED. Smirnova, I. B. pp 199-211 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The behavior of irradiated lymphocytes from the lymph node of mice and the protective effect of cysteamine on the cells following irradiation in vivo and in vitro were investigated. The mice were x-irradiated at a dose rate of 50 to 308 R/min. The investigation demonstrated that the character of radiation damage of lymphocytes from the axillary lymph nodes did not depend on the conditions during irradiation but strongly depended on the conditions after irradiation. In irradiated lymph nodes in situ, the maximum number of cells with a pycnotic nucleus following irradiation in doses of 50 to 3000 R was noted after 4 to 5 hr and did not exceed 20% of the cells in the normal node. After 6 hr the percentage of pathological cells dropped to 3 to 6 and after 24 hr did not exceed 3%. Under conditions of postradiation incubation of lymphocytes in vitro an increase of cells with pycnotic nuclei continued up to 12 hr and reached almost 90% after irradiation in a dose of 2000 R. The use of cysteamine before or immediately after x irradiation both in vivo and in vitro with subsequent incubation in vitro caused a distinct decrease in the number of cells with pycnotic nuclei, without affecting the already-formed pycnosis. Cysteamine apparently specifically prevented pycnosis of the nucleus caused by irradiation, thus presumably preventing the aggregation of chromatin. The injection of cysteamine before or after irradiation in vivo did not lessen the degree

of radiation damage of the lymph node if this was judged by the change in its weight and the size of the cell population. (ATD)

25888 DEPENDENCE OF THE RADIOPROTECTIVE ACTIVITY OF CYSTEAMINE ON OXYGEN PRESSURE (EXPERIMENTS ON EHRICH ASCITES TUMOR CELLS). Graevskii, E. Ya.; Nekrasova, I. V. pp 192-8 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

In experiments carried out on Ehrlich ascites tumor cells, cysteamine injected intraperitoneally into x-irradiated mice did not offer protection additional to anoxia in tumor cells of the abdominal cavity of animals. This permitted the assumption that the protective activity of aminothiols, which has been observed in the presence of markedly lowered oxygen concentrations in microorganisms and at the temperature of liquid air in human kidney cells in culture, was explained by the fact that the protector only increased the degree of anoxia and that in its absence the effect of oxygen was not completely eliminated. The experimental evidence indicated that in the absence of oxygen, cysteamine and probably other aminothiols did not have a radioprotective effect which supplemented anoxia. At high oxygen concentrations the protective effect of cysteamine proved to be less than in air and could prevent the oxygen effect enhancing damage, at least for such types of lesion as, for example, chromosomal aberrations, the frequency of which increased when cells were irradiated in the presence of high oxygen pressures. (ATD)

25889 ROLE OF ENDOGENOUS SH COMPOUNDS IN RADIOPROTECTIVE ACTION OF ANOXIA AND AMINOTHIOLS. Graevskii, E. Ya.; Konstantinova, M. M.; Sokolova, O. M.; Tarasenko, A. G. pp 182-92 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Investigations were made in mice on the long-term effect of oxygen (98%) on the radioprotective activity of aminothiols on one hand and oxygen tension in the tissues of unirradiated animals after injecting them with a protector, on the other. The sulfur-containing substances investigated were β-mercaptopropylamine hydrochloride (MPA), β-mercaptoethylamine hydrochloride (MEA), and cystamine hydrochloride. It was found that in the absence of a protector the sensitivity of the mice to radiation in an oxygen atmosphere did not change in comparison with their radiosensitivity in air. The results of the experiments demonstrated that when the animals were placed immediately before irradiation into an oxygen atmosphere the radioprotective efficacy of MPA and cystamine somewhat dropped. If the animals during the entire period of action of the protector and during irradiation were in an oxygen atmosphere, the radioprotective activity of the protector was appreciably lowered. It was further found that anoxia, serotonin, and aminothiols during their radioprotective activity increased the content of SH-groups in mouse spleen by 14 to 26%. It was suggested that the protective effect was brought about not directly by the agents but by the SH-groups, the level of which increased in the animal tissues under the effect of the radioprotective agents. (ATD)

25890 SYNTHETIC INHIBITORS AND NATURAL ANTIOXIDANTS. ANTIOXIDATIVE ACTIVITY OF LIVER LIPIDS OF MICE DURING IRRADIATION AND THE RADIOPROTECTIVE ACTION OF FREE RADICAL REACTION INHIBITORS. Burlakova, E. B.; Dzyuba, N. M. (Inst. of Chemical Physics, Moscow). Biofizika, 11: 54-7(1966). (In Russian).

Antioxidative activity changes of liver lipids and radioprotective effects of synthetic and natural free radical reaction inhibitors were investigated in Balb line mice (18 to 22 g) irradiated with single 650 and 450 R doses (RUT-200-20-3 unit, 15 mA, Cu 0.5 mm filter, 40 to 50 R/min). Synthetic inhibitors (not described) were administered 15 to 30 min prior to irradiation. Extraction of liver lipids and determination of antioxidative activity were conducted according to methods described in earlier studies. Survival of animals was based on a 30 day period. To determine whether liver lipids of intact animals contained certain properties common to synthetic inhibitors and to avoid the difficulties of in vivo experimentation, liver lipid extracts of intact mice were diluted with methyl oleate and γ-irradiated (^{60}Co, 10 R) with and without oxygen. Findings indicated that with a 650 R dose, antioxidative activity of liver lipids after four hrs was equal to zero, i.e., the extract did not retard methyl oleate oxidation. After five to seven hrs the lipid extracts accelerated methyl oleate oxidation, i.e., the antioxidation values became negative. With a 450 R dose the decrease of antioxidative activity was considerably smaller. Survival of animals irradiated at a 650 R dose was increased by 20 to 25% with administration of the inhibitor 4-methyl-2,6-di-tert-butyl phenol in a 30 mg/kg dose. The same dose administered to control animals did not increase antioxidative activity. But, with the administration of a 100 mg/kg dose to animals irradiated at a 650 R dose, antioxidative activity was decreased and animals failed to survive. Thus, antioxidative activity of liver lipids decreased with the development of radiation sickness and the natural inhibitors were expended during their interaction with peroxide radicals. Synthetic inhibitors of free radical processes administered in doses increasing the antioxidative activity of liver lipids produced a radioprotective effect. (ATD)

25891 THE MULTIPLICATION, SURVIVAL, AND POST-IRRADIATION RECOVERY OF YEAST CELLS IN DISTILLED WATER AND SODIUM CHLORIDE SOLUTIONS OF DIFFERENT CONCENTRATION. Polushkin, B. V.; Tsyran, N. I. (Inst. of Medical Radiology, Obninsk, USSR). pp 90-5 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Yeasts of Saccharomyces vini strain Megri 139-B, received γ irradiation in doses of 8.1 to 43.2 kR at 90 R/sec while suspended in distilled water, NaCl solutions and tap-water (70 to 100 cells/ml). The yeasts were capable of multiplying in distilled water at 30° but did not multiply in 0.5 to 1.5% NaCl solutions. Irradiation suppressed the ability of the yeast to multiply in distilled water and the ability to recover was at the same level as when the irradiated suspension of yeasts was incubated in 0.5% salt solution or in tap-water. Preliminary incubation of the yeasts in nonnutrient media increased their radioresistance. (JPRS)

25892 DYNAMICS OF THE POSTRADIATION MULTIPLICATION OF SCH CELLS DURING REPARATION AND CHEMICAL PROTECTION AGAINST RADIATION. Burlakova, E. V.; Parkhomenko, I. M. pp 318-27 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Experiments were designed to examine the problem of the reversibility of various forms of lesions of SCH cells following γ irradiation and to elicit whether the presence of the irrecoverable portion of the lesion was associated with some definite form of inactivation. The protectors used were aminoethylisothiouronium bromide hydrobromide, propyl gallate, and polyvinyl pyrrolidone. The investigation revealed that the rate of division of γ-irradiated SCH cells forming both normal and abortive colonies did not substantially differ from the rate of division of nonirradiated cells. Various forms of inactivation of the irradiated SCH cells were found to exist and they differed in the extent of damage. Under conditions of protection and postirradiation recovery the more severe forms of lesion could change to milder forms. It was concluded that it was unlikely that some forms of lesion were related only with the reversible part of damage and others were responsible for its irreversible part. (ATD)

25893 PROCESSES OF OXIDATIVE PHOSPHORYLATION IN RAT LIVER MITOCHONDRIA FOLLOWING INJECTION OF CERTAIN RADIOPROTECTORS. Zhulanova, Z. I.; Romantsev, E. F. pp 312-18 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The addition of $NaNO_2$, β-mercaptopropylamine (MPA), β-mercaptoethylamine (MEA) in quantities of 50 and 100 μmol to rat liver mitochondria in experiments in vitro to study their effect on oxidative phosphorylation, caused a decrease in the P/O coefficient. The injection of rats with MPA in a dose of 300 mg/kg led to a decrease of ΔP of the P/O coefficient in liver mitochondria in comparison with the norm. These three protectors when added in quantities of 10, 50 and 100 μmol did not change the optical density of the liver mitochondria during incubation (25 min). In these experiments the permeability of the mitochondria after addition of the protectors did not change contrary to indications in the literature. This was attributed to the comparatively short incubation period. It was postulated that disturbance of oxidative phosphorylation processes after the addition of protectors was not a consequence of changes of permeability. (ATD)

25894 COMPARATIVE EFFECTIVENESS OF POSTIRRADIATION ISOTRANSPLANTATION OF BONE MARROW IN MICE OF DIFFERENT INBRED LINES. Petrov, R. V.; Golovistikov, I. N. (Inst. of Biophysics, Moscow). pp 299-304 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Male C57Bl, CBA and C3H mice, 12 to 13 weeks old and weighing 23 to 25 g, were irradiated at 850, 800 and 750 R ($LD_{100/13}$)

doses, respectively, at a dose rate of 209 R/minute; 24 hours later, they received, intravenously, various quantities of viable nucleus-containing cells of isologous bone marrow prepared directly before administration. The two quantities of cells used were 2 to 4 × 10^5 and 4 × 10^6. Effectiveness was evaluated on the basis of 30 day survival and the dynamics of change of the erythrocytes and leukocytes in the peripheral blood. The effectiveness of the transplantation differed in the different lines; 4 × 10^6 protected 95 to 86.6% of C3H and CBA mice and 62.5% of C57Bl mice; a corresponding effect was observed with a smaller number of cells. In acute radiation sickness the effectiveness depended linearly on the number of cells injected. (JPRS)

25895 EFFICACY OF THE PROTECTIVE ACTION OF ISOLOGOUS BONE MARROW AND SPLEEN TRANSPLANTATION DURING ACUTE RADIATION SICKNESS. Zaretskaya, Yu. M.; Golovistikov, I. N. pp 292-9 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

In experiments carried out on mice protected by isologous bone marrow and spleen transplantations it was found that the injection of bone marrow cells in a quantity of several millions (10^6) protected 90 to 100% of the mice subjected to whole-body γ irradiation in an absolute lethal dose ($LD_{100/11}$). Under the same conditions a 90% survival rate was achieved when 23 to 24 million spleen cells were injected. The rate of recovery and normalization of hematopoiesis in the treated animals was accelerated by increasing the number of injected cells. (ATD)

25896 RELATIONSHIPS BETWEEN CERTAIN BASIC SYNDROMES OF RADIATION SICKNESS IN RADIOPROTECTED AND CONTROL ANIMALS. Stashkov, A. M. pp 282-92 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

In experiments carried out on dogs and rats, the change of concentration of 17-hydroxycorticosteroids (17-HCS) after injecting protectors and total-body irradiation in a dose of 700 R was studied. After x irradiation of the dogs, two phases of an increase in the concentration of 17-HCS in the blood plasma were observed. The initial phase was detected several hours after radiation and was functionally reversible. This reaction probably had a protective nature. The second phase of a prolonged increase in the concentration of 17-HCS was expressed only during the terminal period of radiation sickness. This was an irreversible, pathological, neuroendocrine reaction developing parallel and relative to the irreversible disorders in other systems of the organism. The terminal rise in the concentration ensued earlier, the more quickly the intestinal disorders were manifested. The protectors (cysteamine, cystamine, unithiol, phenatine, antiffeine, and allyl norantiffeine), just as irradiation, caused a primary reaction of increased activity of the hypophyseal-adrenal cortex system. This was expressed by an appreciable rise of the 17-HCS concentration in the peripheral blood plasma. This indicated that the mechanisms of natural and chemical protection developed on a common base and were apparently related. The protective action of the preparations was most often demonstrated as a decrease in the extent of damage to the hematopoietic system and intestinal tract. The reactivity of the adrenals to ACTH remained adequate in all control animals and was expressed somewhat better in the protected dogs during all periods of radiation sickness. This may be due to a decrease in the overall lesions in the hematopoietic and digestive systems or to the favorable influence of the preparations on the endocrine function of the protected animals. The repeated use of ACTH for four days before irradiation increased the survival rate by 33% in comparison with the controls. The endocrine syndrome, while being one of the pathogenetic links of radiation sickness, could not be considered as the most determining cause in the nature of radiation lesions. (ATD)

25897 USE OF HOMOLOGOUS BLOOD SERUM FOR PREVENTION AND TREATMENT OF RADIATION SICKNESS IN DOGS. Raeva, N. V.; Klemparskaya, N. N.; Filina, O. S. pp 274-82 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Experiments were conducted in three variants on mongrel dogs of both sexes: one, the efficacy of sera obtained from the blood of dogs that survived whole-body γ-irradiation of lethal doses was tested; two, fresh plasma obtained from convalescent dogs was used; and three, the influence on radioresistance of active immunization, i.e., preirradiation injection of homologous serum of dog donors γ-irradiated at doses of 7500 to 10,500 R, whose serum contained fresh tissue-decay products. The experiments revealed that the serum of dogs that had suffered acute radiation sickness, when injected repeatedly in quantities of 4 to 5 ml/kg after irradiation of dogs with lethal doses, did not increase the survival rate and did not lengthen the life span; however, the clinical manifestations of radiation sickness were mitigated and changes in the peripheral blood and in the state of natural immunity were decreased. The plasma of dogs with previous acute radiation sickness with (10 to 15 ml/kg two to three times after irradiation of the animals with lethal doses) increased the survival rate, lengthened life span, mollified the manifestations of radiation sickness, and reduced changes in the peripheral blood and in the state of natural immunity. After threefold injection before irradiation of the serum of donor dogs taken immediately after irradiation, there was some protection and a well-evidenced favorable influence on the state of immunological reactivity. (ATD)

25898 EFFECT OF HIGH-POLYMER DNA ON HEMATOPOIETIC PROCESSES DURING ACUTE RADIATION SICKNESS. Rogacheva, S. A. pp 269-74 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Experiments were conducted with white Wistar rats of both sexes that were whole-body γ-irradiated (^{60}Co) at a dose of 1000 R at a dose rate of 20 R/min. Preparations of DNA were injected into the rats intraperitoneally 24 hr after irradiation (5 mg in 2 to 3 ml of physiological saline solution). It was found that in the DNA-treated animals there was a slower decrease in the absolute number of nuclei-containing cells and a more intense restoration of their number than in control animals. The total number of cells in the spleen of the experimental rats six hr after injection of the DNA was three times more, and after 12 hr, two times more, than in the controls. Later, the difference between the experimental rats and the controls leveled off. In the bone marrow of the DNA-treated rats the total number of cells 12, 24, and 72 hr after injection was 60, 70, and 40% above the corresponding control level. It was concluded that one of the mechanisms of the therapeutic action of DNA in acute radiation sickness was its effect on hematopoietic processes. When high-polymer liver DNA was injected into the irradiated animals there was less development of destructive processes and more rapid restoration of the composition of the bone marrow, spleen, and peripheral blood. (ATD)

25899 RADIOPROTECTION AND POSTRADIATION RECOVERY FOLLOWING REPEATED IRRADIATION. Yarmonenko, S. P.; Airapetyan, G. M. pp 262-9 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

In experiments carried out on female mice sodium aminoethylthiophosphate (cystaphos) and 5-methoxytryptamine hydrochloride (mexamine) were used as protectors. The protectors were dissolved in a physiological saline solution and injected intraperitoneally (0.2 ml), 10 to 15 min prior to irradiation. The experiments with repeated irradiation at intervals of 1.5, 3, 6, 9, 18, and 24 hr in a range of total doses causing differentiated bone-marrow or intestinal death in single radiation showed an increase in survival. This increased survival was interpreted as a result of the postradiation recovery of the viability of bone marrow or intestinal cells owing to the elimination of sublethal lesions during the 1.5 to 9 hr after the original irradiation or owing to regeneration during the long periods between irradiation, 18 and 24 hr. The efficacy of the protectors under these conditions was determined by the value of the dose reduction factor and protection offered by one or another radiosensitive system. (ATD)

25900 USE OF SOME MODELS FOR A PRELIMINARY EVALUATION OF THE RADIOPROTECTIVE EFFECT OF AMINOTHIOLS. Kudryashov, Yu. B.; Rachinskii, F. Yu.; Kakushkina, M. L.; Konoplyanikov, A. G.; Mekhtieva, S. M.; Olteanu, V.; Sumarukov, G. V.; L'eu, Le-dak; Slava, E. pp 253-61 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The protective effects of various aminothiol preparations and their derivatives on animals and models are described. The experiments were carried out on mice, yeasts, and a radiomimetic erythrocyte model. On the basis of the data obtained, a complex use of models for a rapid and preliminary assay of the radioprotective action of various agents was proposed. The proposed complex included the use of a radiomimetic erythrocyte model which, within a short time (1 to 2 hr) would permit a preliminary estimate of the protective activity of agents without consideration of their toxic effect on animals. Furthermore, by means of this model it was possible to reveal the potential protective properties of agents that were masked by their toxic effect on animals. A rapid assay, within 1 to 2 days, of the dose reduction factor at the

cell level (after irradiation of diploid yeast cells) was also involved. The use of a cell model had certain limitations in comparison with the radioprotective effects on individual cells and animals. The magnitude of the redox potential in animal tissues should be recorded after injecting the agents in doses close to the maximum permissible. From the kinetic data on the drop in the magnitude of the potential in tissues it was possible to estimate preliminarily the degree and time of the maximum radioprotective effect in animals without their irradiation. The simultaneous use of models permitted making a preliminary selection of radioprotectors, the protective action of which should later be thoroughly determined in animals following their irradiation. (ATD)

25901 PULSED LASER ENERGY IN THE MANAGEMENT OF MULTIPLE PULMONARY METASTASES. Minton, John Peter; Andrews, Neil C.; Jesseph, John E. (Ohio State Univ., Columbus). J. Thorac. Cardiovasc. Surg., 54: 707-13(Nov. 1967).

The application of laser energy for precise destruction of multiple tumor implants in the pulmonary parenchyma of rabbits, and the production of untoward effects on the normal primate lung were investigated. The Nd laser used emitted monochromatic, coherent photon energy at a wavelength of 10,600 Å. Dutch rabbits weighing 2 to 3 Kg bearing a transplantable Brown-Pearce carcinoma were used. The tumor nodules in the lung were positioned at the focal point of the laser beam and exposed to a single pulse of laser energy at 200 to 700 J. The energy delivered to a given tumor implant was directly proportional to the diameter of the tumor. All tumor implants gave the immediate appearance of having been devitalized. Between six weeks and three months after surgery, pleural adhesions were present in each animal. Absence of tumor implants and dense localized fibrous tissue were noted in the lung at the sites of tumor destruction. The effect of laser energy on the normal parenchyma was studied to determine if there were significant differences between the response of rabbit lung and primate lung. The same general technique of laser exposure as in the rabbit experiments was used on five male Macaca mulatta monkeys. Three 200-J laser impacts were delivered to different areas in each lobe. Bleeding and air leaks were minimal at the 200-J level but energies of 300 J or greater produced air leaks and bleeding that required suturing. Laser impacts of 200 J per pulse produced areas of devitalized lung measuring 4 to 5 mm in dia and 4 to 6 mm in depth. Energies greater than this produced correspondingly larger lesions. (BBB)

25902 BIOCHEMICAL MECHANISMS OF RADIOPROTECTOR ACTION. Romantsev, E. F. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 689-97(1967). (In Russian).

The article surveys the findings of reported work on the biochemical mechanisms of radioprotector action. Hypotheses about the mechanism are based on the fact of variation of cell radiosensitivity, possibly by hundreds of times, depending on the physical state of the cell, through biochemical mechanisms. Older animals are more radioresistant than young, and cold-blooded more radioresistant than warm-blooded. Cells in different phases of the life cycle vary in sensitivity, and therefore radiosensitivity can be influenced by temporarily retarding the life cycles with certain chemical agents. Information obtained about the reaction of vitamins P, C, B_1, B_6 and B_{12}, of β-mercaptopropylamine, MEA, L-cysteine, AET and other protectors is presented and analyzed. (JPRS)

25903 LONG-TERM EFFECTS OF A SINGLE DOSE OF METHYL PREDNISOLONE ON ^{35}S LEVELS IN OCULAR AND NASAL TISSUE. Waitzman, Morton B.; Jackson, Richard T. (Emory Univ., Atlanta). Metabolism, 16: 635-43(July 1967).

In rabbits, the effect of corticosteroid hormone treatment on ^{35}S uptake was measured in corneal, scleral, and filtration angle tissue, blood, aqueous humor, and nasal mucosa. A single dose (8mg) of 6α-methyl prednisolone acetate was administered subconjunctivally in one eye. Twelve hours before the animals were killed they received 750 μCi of ^{35}S intraperitoneally. For about 20 to 25 days after the single steroid injection, the treated tissue incorporated less ^{35}S than control tissue. For the following 15 to 20 days the steroid-treated tissue incorporated more ^{35}S than control tissue. The alterations of ^{35}S in the tissues were directly related to ^{35}S levels in the blood. The data imply that a single injection of a depot steroid can cause an alteration in the level of ^{35}S for as long as 38 days. (BBB)

25904 RADIATION PROTECTION STUDIES (IN VITRO) WITH ORGANOSELENIUM COMPOUNDS. I. Brucker, W.; Bulka, E. (Univ., Greifswald, Ger.). Stud. Biophys., 1: 253-5(1966). (In German).

Inhibitory effects of several organic Se compounds on splitting of orthophosphate from adenosine triphosphate caused by 200-kV x irradiation were studied. The irradiation doses used ranged from 270 to 800 kR. The compounds tested included 2-p-anisidino-5-phenylselenadiazine hydrobromide, 4-p-methoxyphenylselenazolyl-2-hydrazine hydrochloride, 2-anilino-4-methylselenazole hydrochloride, and 2-amino-4,5-dimethylselenazole hydrochloride. The effects of each compound were tested at final molar concentrations of 10^{-4}, 2×10^{-4}, and 10^{-3}. Only the 2-amino-4,5-dimethylselenazole hydrochloride had any significant radioprotective action. As compared to control samples, this compound decreased orthophosphate formation to 72% and 22% at molar concentrations of 2×10^{-4} and 10^{-2}, respectively. A similar protective effect on the activity lost by urease after irradiation was also observed, but the activity of this enzyme was depressed considerably by this selenazole even without irradiation. (auth)

25905 CEREBRAL BLOOD FLOW STUDIES WITH SODIUM PERTECHNETATE ^{99m}Tc AND THE SCINTILLATION CAMERA. Burke, Gerald; Halko, Arlene (Michael Reese Hospital and Medical Center, Chicago). J. Amer. Med. Ass., 204: 319-24(Apr. 22, 1968).

The scintillation camera was used for cerebral blood flow studies with ^{99m}Tc sodium pertechnetate. The use of an electronically split crystal linked to a dual-pen rectilinear chart recorder permitted constant visual monitoring of blood flow through major cerebral arteries concomitant with the inscription of independent right- and left-sided count-rate curves. Abnormalities of cerebral blood flow were readily demonstrable with this technique; the scintiphotographic sequence was found to be of particular value in the visualization of middle cerebral artery occlusion. Cerebral mode transit time derived from the count-rate curves was characterized in 44 neurologically normal subjects. A gradual but consistent increase in cerebral mode transit time with advancing age was noted. Moreover, there was significant overlap between mode transit time data in 15 patients (all over 50 years of age) with recent cerebrovascular accidents and that obtained in a like number of age-matched normal subjects. The study of cerebral blood flow with the split-crystal scintillation camera and ^{99m}Tc sodium pertechnetate represents an advance over previous methodology and merits continued investigation. (auth)

25906 MEASUREMENT OF SPLENIC RED-BLOOD-CELL MASS WITH RADIOACTIVE CARBON MONOXIDE. Glass, H. I.; De Garreta, A. C.; Lewis, S. M.; Grammaticos, P.; Szur, L. (Royal Postgraduate Medical School and Hammersmith Hospital, London). Lancet, 1: 669-70(Mar. 30, 1968).

A method was developed for direct in-vivo measurement of the red-blood-cell (R.B.C.) mass in the spleen by radioisotope scanning after administration of erythrocytes (R.B.C.) labeled with ^{11}C-carbon monoxide. Measurements were carried out in four healthy volunteers and in two patients. The normal R.B.C. was between 20 and 45 ml. In one of the patients the spleen was just palpable and its R.B.C. mass was 183 ml; in the other patient the spleen was grossly enlarged and its R.B.C. mass was 1010 ml. If considered necessary to delineate the spleen with greater precision, a second scan was carried out after injection of 1-mercuri-2-hydroxypropane damaged R.B.C.'s labeled with ^{81}Rb. The quantity of isotope used would give a whole-body radiation dose of 8.8 mRad, an acceptably low level. (auth)

25907 EXAMINATION OF INTERNAL TISSUES BY HIGH-ENERGY SCATTERED X RADIATION. Lale, P. G. (Guy's Hospital, London). Radiology, 90: 510-17(Mar. 1968).

The x-ray output of a 5.6 MeV linear accelerator was collimated to a 3 mm beam and passed through a patient. X rays scattered from a small volume of tissue were accepted by a large focusing collimator behind the patient and reached a liquid scintillator, while the direct beam was absorbed. The x-ray beam and collimator were arranged to scan the patient. Light from the scintillator modulated the brightness of a cathode-ray tube spot, whose movements corresponded with that of the beam, building up a picture of the density variations in the focal plane. The tissue thickness observed was effectively 2.5 cm at a focal distance of 15 cm from the collimator face. The lateral resolution was 3 mm and density resolution 4%. A number of live scans were made over areas 15×18 cm^2, in times of fifty seconds. In a comparison with tomography using inanimate objects, a superior resolution was obtained with the technique described. It is concluded that the method can be developed far beyond its present level to provide clinical information as yet unattainable and with the possibility of national screening. (auth)

25908 QUESTION OF THE PRIMARY PHYSICOCHEMICAL MECHANISMS OF RADIATION INJURY. Tarusov, B. N. (Moscow State Univ.). Radiobiologiya, 7: 670-7(1967). (In Russian).

The article presents a survey of Soviet work on the subject in the period 1960–1967, mainly on the mechanisms of oxidative reactions occurring in irradiated cells. Lipids have been found to

be the most radiochemically oxidizable cell substrate, and under the effect of radiation a non-stationary chain reaction develops which destroys the structural lipids; the appearance and quantity of intermediate and end products have been studied, with wide use of the EPR method to study the formation of free radicals during that process. The EPR method has also been used to study ultraweak luminosity in the blue-green region of the spectrum of all viable cells of animals and plants, resulting from ketone formation through recombination of peroxide radicals during oxidation of hydrocarbons and lipids; that luminosity gives information about the development of oxidative processes in the structural lipids. An ultrasensitive photomultiplier has also been developed to measure that luminosity. Another method is based on graft copolymerization of monomers tagged with radioisotopes. It has been shown that the normal stationary development of the oxidation process in lipids, on a very low level, changes after irradiation into a non-stationary accelerating process. The localization of that reaction has been studied by the same methods. A new class of toxic substances of a lipid character (peroxides, epoxides, aldehydes, ketones and unsaturated fatty acids) which are capable of initiating radiomimetic oxidation reactions in lipids has been found. There are indications that there is a direct connection between the radicals and radical reactions, radiotoxic substances and other detectable active substances of lipid origin in reactions initiated in the lipids of the organoid membranes. Finding out the mechanisms which determine the stability of the lipid component is one of the principal new questions, as it is closely connected with radioprotection and radiosensitivity, in which lipid, lipo-soluble and even water-soluble antioxidants play a principal role. With the discovery of ultraweak luminosity it became possible to take into account and monitor the antioxidants in that process with a very sensitive method of recording chemiluminescence. It has been found that in acute irradiation the quantity of antioxidants drops in parallel with increase of the quantity of radicals. Information obtained indicates that the antioxidants are the principal factor assuring the stability of lipid structures in membrane systems and preventing under conditions the development of self-accelerating chain reactions. Radiant energy disturbs the antioxidant equilibrium by destroying antioxidants, and when that occurs intensively the self-regulating mechanism cannot restrain it and a chain oxidation rapidly occurs. Research indicates it is possible during irradiation to mobilize in the cells thio compounds with antioxidant properties. Apparently both fatty acid and water radicals have a role in radiation oxidation. Questions of the carcinogenic action of ionizing radiation remain unsolved, but a connection has been found between the action of ionizing radiation and that of carcinogens—the principal reacting substrate is the biolipids, mainly the phospholipids, in both cases. The use of new methods in recent years has shown that enzymes are placed on the organoid cell membranes but the electron transport is accomplished on the phospholipids of the membranes, and that bridge is very vulnerable; this explains the paradox that the system clearly suffers but the enzymes derived from it are normal. Meriting attention is the fact that the lysosomes have the greatest reactivity to the effect of ionizing radiation. The development of a very persistent aggressive oxidation reaction in the lysosome phospholipids still cannot be explained, as the chemical structure of the latter has not yet been determined. (JPRS)

25909 PECULIARITIES OF RADIATION SICKNESS CAUSED BY PARTIAL OR IRREGULAR IRRADIATION AND THE POSSIBILITIES OF USING AUTOTRANSPLANTATION OF BONE MARROW UNDER THOSE CONDITIONS. **Strelin, G. S. (Central Scientific Research Roentgeno-Radiological Inst., Leningrad). Radiobiologiya, 7: 751-65(1967). (In Russian).**

The article presents a survey of the literature from 1928 to 1967 on the subject, dealing mainly with experiments and observations of the importance of screening part of the bone marrow and of irregular irradiation on the course of radiation illness in mice, rats and monkeys, connected with work on screening and transplantation in invertebrates, with study of the effects of irradiation through grids and with a large amount of work on the recovery of various tissues after radiation damage in connection with their regenerative activity. It has been found in experiments through grids and with autotransplantation of unirradiated parts of the bone marrow that the unirradiated tissues stimulate homopoiesis suppressed by irradiation. (87 references.) (JPRS)

25910 PROBLEM OF POST IRRADIATION RECOVERY IN THE LIGHT OF RADIOTOXIN THEORY. **Kuzin, A. M. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 744-50(1967). (In Russian).**

The article presents a survey of the literature from 1945 to 1967 dealing with the paths of formation of radiotoxins under the effect of distant γ- or x-irradiation, their role in radiation damage of the cell, and the mechanisms of postirradiation recovery. The article deals mainly with the path of recovery in which the post-irradiation reduction of effect consists in halting the reactions leading to the accumulation of radiotoxins. In studies of plant seeds it was found that a decisive stage in damage of cells is interaction of radiotoxins with the DNA of the nucleus and that damage can be reduced by washing the radiotoxins from injured tissues with 2% urea solution. The same method has been successfully used on frogs. In seeking new ways to reduce postirradiation damage, methods directed toward reducing the level of radiotoxins in the irradiated organism cannot be disregarded. 59 references. (JPRS)

25911 NUCLEAR MEDICAL LABORATORY METHODS. II. FUNDAMENTALS OF RADIATION PHYSICS AND MEASUREMENT TECHNIC. **Frost, Dietrich (Staetische Krankenhaus, Berlin). Med. Lab. (Stuttgart), 19: 266-72(Nov. 1966). (In German).**

The basic fundamentals of radiation physics, measurement procedures and the properties of naturally occurring and synthetic radioisotopes are discussed. Characteristics of radioactive decay were outlined. Radiation physics, as exemplified by the effects of photons and electrons on tissues, is discussed briefly. Dose evaluation of various energies and qualities of irradiation in bone and soft tissue are compared with measurements made in air and water. The meanings of "dose equivalent" and "relative biological effects" are defined. The requirement to be able to evaluate doses well enough to avoid irradiation injury and to use irradiation effectively is discussed. Methods and devices such as ionization chambers, proportional counting tubes, G-M tubes, and scintillation counters are described. Principles of operation of the scintillation counter are described in detail, and its characteristics are illustrated. Some applications of scintigraphy in scintiscanning techniques are described and illustrated. (BBB)

25912 EVALUATION OF THE COMBINED RESPONSE TO X RAYS AND CHEMICAL AGENTS. **Marsh, Howard John. Cleveland, Western Reserve Univ., 1966. 226p.**

Thesis.

The combination of chemotherapy and radiotherapy in the treatment of malignant diseases has been advocated in the hope that a response could be achieved that was unobtainable with either therapy alone. An attempt is made here to employ the statistical techniques of experimental design, mathematical model building, parametric estimation and statistical testing of hypotheses in order to clarify the problem of evaluating the combined effect of therapeutic agents. Specifically, the combined effects of chemotherapeutic agents and x ray were investigated. Murine leukemic lymphoblasts, L5178Y, growing in tissue culture were chosen for the biological system in which the combined effect was evaluated. X rays and the chemotherapeutic agent, IUDR, were administered to the tissue culture system as defined by a 4 ×4 factorial design. By including the zero dose level for each agent in the factorial design, it was possible to include untreated cells, singly treated cells and cells treated with combinations of both agents in each experiment. Growth characteristics of the treated cells were observed directly and they provided the basis for the mathematical estimation of the proportional mortality response. Dose response curves were constructed for each single agent, allowing the distribution of tolerances to each agent to be characterized. The responses to treatment combinations of the two agents were then assessed. Data obtained from our laboratory concerning the joint action of x ray and IUDR were consistent with the proposed mathematical model allowing no significant overlap of sites of action and no significant correlation between the tolerances of the two agents. It was concluded that in our experimental conditions x ray and IUDR acted as dissimilar agents, whose effects were simply additive. It appears that combination therapy involving x ray and chemotherapeutic agents produces a predictable response at least in the investigations considered. Characterization of the joint response varied from being the result of dissimilar to similar action. However, in all cases the data were consistent with predicted responses based on the proposed mathematical model for the joint response to combinations of toxic agents. Based on these findings, the role of the tested chemotherapeutic agents as adjuncts to radiation therapy can be seriously questioned. For agents whose joint action can be characterized by our mathematical model, the ideal choice would be that one that has complete correlation of tolerances with x ray and whose sites of action completely overlap those of x ray. Since x ray itself is an agent with such properties, investigation of chemotherapeutic agents for this property may well be unnecessary. (auth)

25913 ADJUVANT THERAPY FOR ADVANCED OVARIAN MALIGNANCY. **Decker, David G.; Mussey, Elizabeth; Malkasian, George D. Jr.; Johnson, Carl E. (Mayo Clinic, Rochester, Minn.). Amer. J. Obstet. Gynecol., 97: 171-80(Jan. 1967).**

Clinical results and complications of treatment of 91 patients with advanced ovarian carcinoma with 250-KV x rays, ^{60}Co, or a linear accelerator, combined with cyclophosphamide, are reported. Cobalt-60 teletherapy was administered over four to five weeks, through a large anterior and a large posterior portal designed to include all of the peritoneal surface. Therapy was given to alternate fields six days of the week, for a total midplane dose of 3500 rad. The kidneys were not shielded. If toxic symptoms occurred one or two days intervened until the patient was able to continue or until the leukopenia lessened. In later patients the total amount of irradiation administered was decreased to lessen the severe leukopenia and weakness. Thus the total midplane dose of radiation was reduced to 2000 to 2500 rad, administered during a three to five week period. Other patients were treated according to the so-called erythema dose technique, with 250-KV x rays, and in another group an eight-day course of radiation was administered with the linear accelerator through four anterior and four posterior portals in rotation, 600 rad per treatment. The combination of high-dosage ^{60}Co teletherapy and cyclophosphamide was found to be very debilitating, and with exception, nausea, and vomiting developed. In most patients radiation therapy had to be interrupted for two days or more because of weakness, nausea and vomiting, or a profound leukopenia. Minimal leukocyte counts occurred at an average of 11.9 days after chemotherapy was started. Radiation nephritis was a complication feared in the high-dose range since no kidney shielding was used, but none of the 35 patients showed evidence of nephritis. However, one patient receiving reduced-dosage radiotheraphy developed radiation nephritis syndrome. In general, decreased radiation doses reduced the debilitating general effects and the depressing effect on the bone marrow. Loss of hair on the scalp to a varying degree occurred in about half the patients, but there was no interference with wound healing in any patient. Hemorrhagic cystitis was rare, but one patient died of uncontrollable bladder hemorrhage. Cure did not result from the therapy, but modification of tumor growth was apparent. Palliation of the disease and prolongation of useful life occurred in some patients. (BBB)

25914 REACTIVITY OF IRRADIATED ANIMALS TO TOXIC AND NON-TOXIC DOSES OF PENTETRAZOL AND CAFFEINE. Voicu, V. A.; Muresan, V.; Nicolau, E. Radiobiol. Biol. Med., 113-8(1967). (In Rumanian).

An attempt was made to elucidate the trend of sensitivity changes against pentetrazole at various intervals in the course of the radiation disease in irradiated animals. Investigations were also performed on the dynamics and lethality index of irradiated animals following the administration of non-toxic pentetrazole or caffeine doses as against a control batch of irradiated animals. Mice exposed to 700 R were used for the estimation of pentetrazole LD_{50} at 1, 4, and 7 days after irradiation. The lethality index was noticed in irradiated rats (batches of 30 and 40 animals) exposed to 800 R. The findings revealed a significant decrease in LD_{50} in the course of the experimentally-induced irradiation disease. In caffeine-treated irradiated animals a shifting of the lethality curve to the right was found, the lethality index recording a marked decrease as compared to controls. (auth) (Rumanian Sci. Abstr.)

25915 MECHANISMS OF RADIATION INACTIVATION OF ENZYMES IN DILUTE SOLUTIONS. Brustad, Tor (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway. Univ. of California, Berkeley). pp 384-96 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

A study of the inactivation by x-rays of the enzymatic activity of RNAase in dilute aqueous solutions of various pH is carried out. From the radiation injury observed in the presence of O_2, N_2O, and N_2, it appears that the sensitivity of RNAase to inactivation by OH radicals is relatively pH-independent, whereas the sensitivity in solution to H atoms keeps rising as pH is reduced. These studies are extended by comparing the radiosensitivities of lysozyme, under various experimental conditions, when irradiated with densely ionizing C^{6+} ions and with sparsely ionizing x-rays. Within the pH range studied the radiosensitivity in N_2 atmosphere when irradiated with C ions was less than 10% of that observed for x-rays. Over the entire pH range studied, oxygen protects against injury from C ions as well as from x-rays, but the degree of this protection is smaller when densely ionizing radiation is used. The radioprotection at pH = 5.0 of lysozyme in O_2-free solution by ethanol, glycerol, histidine, and cysteine was studied. In order to provide the same degree of protection against C ions as against x-rays, protector concentrations approximately twice as high were required. (auth)

25916 RADIATION EFFECTS IN TUMORS. Mendelsohn, Mortimer L. (Univ., Pennsylvania, Philadelphia). pp 659-75 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Precepts of cellular radiation biology are applied to a model tumor-host system; results are evaluated in terms of available experimental data and the gaps in man's current understanding. The effects of the parameters of the simulated tumor-host system that stem from cell proliferation, clonogenesis, and oxygen abundance and the effects of dose fractionation on the radiosensitivity of tumors are primarily discussed. (B.S.L.)

25917 PHOTOCHEMICAL INTERACTION BETWEEN SKIN-PHOTOSENSITIZING FUROCOUMARINS AND DNA. Musajo, L. (Univ., Padua. Centro Nazionale di Chimica del Farmaco, Padua). pp 803-12 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Various aspects of the photoreaction between skin-photosensitizing furocoumarins and native DNA are presented. The procedures used to determine the reactive sites of DNA and furocoumarins for photoreaction are described and the results are discussed. It was concluded that the 5,6-double bonds of the pyrimidine bases were the reactive sites. The effects of long wavelength uv-irradiation (30 min at 365 mμ) in the presence of skin-active furocoumarins (psoralen, xanthotoxin, and bergapten) on the tumor-producing capacity of Ehrlich ascites tumor cells was investigated; after irradiation, the cells were intraperitoneally transplanted in mice. Based on survival of the mice, it was shown that the skin-active furocoumarins increased the inhibitory effect of the radiation. With xanthotoxol, a skin-inactive furocoumarin, no inhibition was obtained and all mice died. The disappearance of the tumor-producing capacity was attributed to the photochemical linkage of furocoumarins to DNA of the tumor cells. (B.S.L.)

25918 USE OF PENTOXYL IN RADIATION PROCTITIS. Klunichenko, A. M. (Altai Medical Inst., Barnaul, USSR). Vop. Onkol., 13: No. 6, 109-11(1967). (In Russian).

Pentoxyl (0.2 g three times daily and 0.2 g in suppositories two times daily) was used in 76 patients with late radiation rectitis that occurred after the combined x-ray therapy of cancer of the cervix uteri and uterine body. The course of treatment lasted for 2 to 3 months. To lessen the local irritant effect of pentoxyl, 0.01 g of dionin was added to suppositories. The elimination of the symptoms of rectitis was noted in all patients. (auth)

25919 ISOTOPE UPTAKE AND SCANNING OF STOMACH IN MAN WITH ^{99m}Tc–PERTECHNETATE. Harden, R. McG.; Alexander, W. D.; Kennedy, I. (Western Infirmary, Glasgow). Lancet, 1: 1305-7(June 17, 1967).

The short half life of ^{99m}Tc, coupled with the near-absence of particulate radiation, permits relatively large doses to be administered with little hazard to the patient, and the 140 keV γ radiation is optimal for scanning. Quantitative uptake and scanning studies of the stomach following administration of 800 μCi of this isotope in fasting man are reported. The resulting radiation dose to the stomach and thyroid glands was less than 0.2 rem. The abdomen was scanned in the anteroposterior position at intervals up to 1 hr after the tracer dose. A phantom containing a known dose of the isotope was scanned under identical conditions. By comparison it was possible to express the net dot-counts over the stomach as a percentage of the injected dose. The stomach was clearly displayed within 15 min of injection of the isotope. The gastric uptakes at 6, 20, and 60 min in 10 normal patients averaged 1.2, 3.0, and 6.8%. The scanning techniques described gave both anatomical and physiological information about the stomach. Such scanning has the advantages of speed, little inconvenience to the patient, and minimal radiation dosage. (BBB)

25920 COMBINED CHEMOTHERAPY AND RADIOTHERAPY. PRELIMINARY RESULTS OF CLINICAL TRIAL OF HYDROXYUREA AND X-IRRADIATION IN THE TREATMENT OF EPIDERMOID CANCERS OF THE HEAD AND NECK. Lerner, Harvey J.; Beckloff, Gerald L. (Pennsylvania Hospital, Philadelphia). Amer. Surg., 33: 165-70(Mar. 1967).

Evidence for a synergistic effect of x rays and hydroxyurea was sought in 13 patients with advanced cancer. They were treated with hydroxyurea in a single oral dose of 80 mg/Kg every third day. Administration of hydroxyurea was begun a week prior to radiotherapy and was continued indefinitely. X irradiation (1 MeV) was given three times a week for 6 to 10 weeks in full therapeutic doses, to a maximum of 6500 R. Xylocaine was used intra-orally for relief of discomfort caused by the mucositis and radiodermatitis

that occurred within 10 days after the start of radiotherapy. All patients showed prompt regression of the primary tumors, with maximal regression evident after four to six weeks. Nine of the 13 patients were clinically free of the disease for two to 13 months. The combined use of hydroxyurea and irradiation appeared to be more effective in the treatment of epidermoid cancers of the head and neck than either alone. A possible mechanism of interaction between the two forms of treatment is discussed. (BBB)

25921 PROTECTIVE EFFECT OF MAGNESIUM PEMOLINE AGAINST LETHAL DOSES OF X IRRADIATION. LeVan, H. (Univ. of Illinois, Chicago). Experientia, 23: 1058-9(Dec. 15, 1967).

It was observed that magnesium pemoline, known as a memory enhancing drug, had a radioprotective effect on experimental animals. A total of 360 mice was divided into three groups of 120 each. All mice were exposed to 50 R of x radiation on the first day. On the second day, half of the mice in each group was injected with magnesium pemoline, and the other half (controls) with bacteriostatic water. All mice were then exposed to 50 R a second time. On the third day, the first group was exposed to an additional 800 R. The second and third groups received this lethal dose on the fifth and seventh days, respectively. Mortality in each group was observed and recorded daily. In all three groups the control animals all died on the eighth or ninth day of the experiment. In the first group, 48% of the mice injected with magnesium pemoline survived; in the second group, 35% of the protected mice survived; and in the third group, 50% survived. Results are tabulated. (H.L.W.)

25922 RADIOISOTOPES AND THYROID FUNCTION: CURRENT TRENDS. Quinn, James L.; Hallenbeck, George S. (Chicago Wesley Memorial Hospital). Radiol. Clin. N. Amer., 5: 249-53(Aug. 1967).

Physical and biological characteristics of ^{123}I, ^{125}I, ^{131}I, ^{132}I, and ^{99m}Tc are compared and their relative value in thyroid scanning is discussed. Effectiveness of various techniques employing these isotopes in thyroid diagnosis is also compared. It was possible to improve thyroid scanning techniques through the use of lower energy radioisotopes (^{123}I, ^{125}I, ^{99m}Tc), superior collimators (1000 hole with 4- to 6-mm resolution at the plane of focus), and better recording techniques (data blending, color dot recording, information density of about 1800 counts per cm^2), but thyroid scan interpretation has become more difficult. Nonuniformity of thyroid radioactivity in from one-third to one-half of the population is now being noted. Diffusely enlarged thyroid glands in patients with Graves' disease frequently have areas of decreased uptake in the center of the gland. (BBB)

25923 IMPORTANCE OF NUCLEAR REACTORS AND PARTICLE ACCELERATORS FOR MEDICINE. Lorenz, W. J. (Deutsche Krebsforschungszentrum, Heidelberg). Kerntechnik, 9: 567-9(1967). (In German).

In the isotope centers nuclear reactors and particle accelerators produce radionuclides mainly employed in medicine and biology. Furthermore, betatrons, electron linear accelerators and cyclotrons for protons and α-particles have proved very useful in cancer therapy. Through the application of short-lived isotopes, activation analysis and stable tracer technique, research reactors and compact cyclotrons have turned out to be very important for medical use. The latest developments in the field of high-energy particle accelerators make accessible for radiation therapy the efficient π^--mesons and heavy ions of high energy. (auth)

25924 INDIRECT LYMPOGRAPHY OF THE LUNGS. Hoefer, R.; Benzer, H. Strahlentherapie, Sonderbaende, 65: 410-14 (1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Following submucosal intrabronchial injection of colloidal ^{198}Au regional lymph nodes were demonstrated by scintigraphy. In some cases, the injected ^{198}Au colloid was obviously distributed throughout the whole lymphatic system of one lobe of the lung since the whole lobe could occasionally be visualized by scintigraphy after submucosal injection of the tracer. (auth)

25925 AVOIDANCE OF EARLY AND LATE COMPLICATIONS IN THE INTRAPERITONEAL APPLICATION OF COLLOIDAL RADIOGOLD ^{198}Au. Mueller, J. H. (Univ., Zurich). Strahlentherapie, Sonderbaende, 65: 231-8(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The practical value of intravascular, interstitial, and intracavitary therapeutic administration of radioactive colloids is now established. Statistical evidence for the curative results of intra-peritoneal ^{198}Au colloid administration following surgery is now available in ovarian cancer therapy. Insufficient clinical competency may involve the danger of some complications when using this particular intracavitary administration procedure. Such complications, however, are avoidable, if all the clinical, operative, and technical parameters receive adequate attention in each individual case. (auth)

25926 SOME CONSIDERATIONS AND LONG-TERM RESULTS ON THE TREATMENT OF INOPERABLE TUMORS OR RELAPSES BY RADIOISOTOPES ADMINISTERED BY IMPLANTATION OR INTRAARTERIALLY. Dogliotti, A. M.; Caldarola, L.; Badellino, F. (Univ., Turin). Strahlentherapie, Sonderbaende, 65: 239-45 (1967). (In French).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The use of internal β therapy as an auxiliary therapeutic technique is discussed. In some tumors it was employed as a substitute for surgery, when this was feasible. The effects and results up to four years after treatment obtained in 400 patients with various types of tumors are reported. Treatment involved administration of ^{32}P labeled compounds. The use of radioactive colloids for local infiltration during surgical operations or, in some cases, prophylactically before surgery; labeled resin microperes injected intraarterially in the region of the tumor, made possible by accurate demarcation of the regional arterial vascular territory; and labeled aluminum pellets implanted directly into the tumor is reported. It was found that the adoption of these techniques are feasible under conventional surgical conditions. Although the lapse of time after treatment is too short to allow statistically significant conclusions to be drawn, a preliminary assessment of the long-term results is possible after two to four years. (auth)

25927 HYPOTHYROIDISM RISKS AFTER ^{131}I THERAPY OF THE THYROID GLAND. Heilmann, H.-P.; Ernst, H. (Univ., Berlin). Strahlentherapie, Sonderbaende, 65: 246-59(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

More than 1300 thyrotoxic patients were treated with ^{131}I. Detailed follow-up studies of a representative number of these patients are reported. The incidence of therapy-induced hypothyroidism was higher than expected. Radioiodine and other conventional tests were used to confirm the diagnosis of hypothyroidism. Routine examinations performed six months after a therapeutic dose of radioiodine are only rarely of prognostic value with regard to late hypothyroidism. The influence of the amount of radioactivity administered and of the initial hormonal situation on the incidence of therapy-induced hypothyroidism are discussed. It is concluded that the selection of patients and the determination of the therapeutic doses in diffuse hyperthyroidism must be re-examined. (auth)

25928 DIAGNOSTIC RESULTS WITH RIHSA MYELOGRAPHY AND RIHSA VENTRICULOGRAPHY. Zeitler, E.; Dietz, H.; Schuermann, K.; Wolf, R. (Univ., Mainz). Strahlentherapie, Sonderbaende, 65: 402-9(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Results in 90 patients showed that ^{131}I-human serum albumin myelography is a valuable aid in the diagnosis of intraspinal tumors and arachnoiditis. Furthermore it is possible to simultaneously perform a scintigram of the ventricles. Ventricular scintigraphy is valuable for the demonstration of occlusions or fistulae in the region between cranium and spine. Ventricular scintigraphy after direct injection of the tracer into the ventricular system is also possible. (auth)

25929 MEDIZINISCHE RADIOLOGIE. (Medical Radiology). Arndt, Joachim. Jena, Ger., VEB Gustav Fischer Verlag, 1967. 375p. Geb. MDN 38.-.

The radiophysical and radiobiological principles of medical radiology are reviewed in some detail. Radiation damage and radiation protection are discussed with respect to the damage that ionizing radiation can cause and the radiation syndrome. An introduction is given to the techniques and methods of radiodiagnosis, nuclear medicine, and radiotherapy. (J.S.R.)

25930 ZASHCHITA I VOSSTANOVLENIE PRI LUCHEVYKH POVREZHDENIYAKH. (Protection Against and Repair of Radiation Injuries). Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. 332p.

Separate abstracts were prepared for 47 papers of the book.

Topics include the effectiveness and mechanisms of radioprotective compounds on animals and plants at the molecular, subcellular, cellular, organ, and systematic levels. (B.S.L.)

For abstracts of individual papers see: 25737–25740, 25805–25810, 25863–25875, 25882–25889, 25891–25900, 25930, 26000–26002, and 26008–26010.

25931 RADIOAKTIVE ISOTOPE IN KLINIK UND FORSCHUNG. BAND VII. 48TRAEGE AM GASTEINER INTERNATIONALEN SYMPOSION 1966. (Radioactive Isotopes in Clinics and Research. Volume VII. Contributions to the Gastein International Symposium 1966). Fellinger, K.; Hoefer, R. (eds.). Strahlentherapie, Sonderbaende, 65: 1-488(1967). (In several languages). (CONF-660121).

Separate abstracts were prepared on 44 papers that discuss uses of radioisotopes in diagnosis and therapy. (C.H.)

For abstracts of individual papers see: 25250–25255, 25773–25777, 25924–25928, 25932–25958, and 25998.

25932 THE PREPARATION OF ^{99m}Tc FOR CLINICAL USE. Keeling, D. H.; Bryant, T. H. E. (Middlesex Hospital, London). Strahlentherapie, Sonderbaende, 65: 1-7(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Technetium-99 is now readily available for clinical use in the form of ^{99}Mo-molybdate generator columns. Because of the favorable characteristics of ^{99m}Tc regarding dosage, μCi quantities are used, this with the relatively short half-life of the mother isotope ^{99}Mo means that the generator columns are of the order of tens to hundreds of μCi. Procedures for the handling of the column, elution, and the preparation of both oral and intravenous doses of $^{99m}TcO_4$ were critically examined with particular attention to the radiological safety of the staff performing the tests. Dose rate data obtained for both preparation of the dose and from the patient are given, together with measurements of the biological half-life. The relevant details of the procedures are described. The effectiveness of methods for protecting the patients' thyroid are discussed with an appraisal of their relative merits and disadvantages, both as regards their radiological and pharmacological safety and their convenience. (auth)

25933 THE USE OF DATA BLENDING FOR ^{99m}Tc BRAIN SCANS. Christie, J. H.; Rodriguez-Antunez, A.; MacIntyre, W. J. (Western Reserve Univ., Cleveland). Strahlentherapie, Sonderbaende, 65: 8-18(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The use of data blending techniques in photoscanning has involved a large display dot of one to three cm in diameter, made up of small points of light arranged in quasi-Gaussian distribution with the highest intensity at the center. Each point of light is approximately one μ in diameter and as many as 10,000 points were incorporated to make up one display dot. Since the amount of light transmitted is very small, high counting rates must be obtained in order to achieve a statistical blending. The increments of line spacing were small in comparison to the circle diameter so that up to 32 passages of the light beam may be superimposed over the same area of film. Usual counting rates for large organ scanning have required approximately 1500 counts per square centimeter. With each count representing 10,000 points of light this means the collection of 15 million dots per square centimeter. For brain scanning such counting rates were achieved only with ^{99}Tc. With large crystal (up to eight inch diameter) scanners this counting rate has allowed sufficient blending to delineate clearly the major vascular structure in the face and head. This includes the large venous regions such as the paranasal, transverse, and straight sinuses. The linearity of the system has allowed these widely differing areas of deposition to be recorded on the same scan without the need of cut-offs, accentuation, or multiple playback. (auth)

25934 GAMMA ENCEPHALOGRAPHY USING PERTECHNETATE-99m. Quinn, J. L.; Heiser, W.; Ciric, I. S. (Northwestern Univ., Chicago). Strahlentherapie, Sonderbaende, 65: 19-28 (1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The use of $^{99m}TcO_4$ for brain scanning is discussed. The main advantages of this material over other agents are the shorter half-life (6 hours) and the nearly pure monoenergetic γ emission of this nuclide. Because of these physical properties large doses of ^{99m}Tc can be administered, resulting in increased counting rates, faster scanning speeds, and decreased radiation to the patient. A standard commercial 3 inch crystal scanning system was modified to travel 192 cm/min. Using this machine a view of the brain can be recorded in 5 minutes. The major disadvantage of pertechnetate is the relatively slow blood clearance rate. Because of this there is greater blood background during the recording which may interfere with detection of lesions in the posterior fossa, sellar, and pontine regions. None the less, pertechnetate is as accurate in detecting primary and metastatic intracranial neoplasia (85%) as other agents reported to date. Pertechnetate is as non-specific as chlormerodrin in depicting non-neoplastic lesions such as cerebral infarct, abscess, scalp trauma, and arteriovenous malformation. To date, 1167 pertechnetate scans were performed, and 92 proven intracranial neoplasms were detected and localized by the pertechnetate brain scan, while 17 were missed during the same period. In addition, positive brain scans were observed in 77 cases of various non-neoplastic intracranial diseases. (auth)

25935 THE USE OF ^{99m}Tc FOR THYROID SCANNING AND THYROID FUNCTION TESTING. Tothill, P.; Irvine, W. J. (Royal Infirmary, Edinburgh). Strahlentherapie, Sonderbaende, 65: 29-36(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

In a series of patients with various states of thyroid function, scans were performed with both ^{99m}Tc and ^{131}I and results were compared both qualitatively and quantitatively. Because only the trapping phase of the gland is involved in the concentration of technetium, thyroid uptake is much lower than with iodine, which becomes organically bound. It is necessary to administer about ten times as much activity of ^{99m}Tc as ^{131}I in order to obtain similar pictures. However, because of the short half-life, the low energy γ radiation, and the absence of β radiation, the radiation dose is still very much lower when ^{99m}Tc is used. Best results are obtained when the material is injected intravenously and scanning performed one half to one hour later. Oral administration may be used, but absorption is dependent on the state of fasting and may not be reliable. There is some correlation between thyroid uptake of technetium and the degree of thyroid function. Because of the high blood and extravascular background, simple counting of neck radioactivity does not yield an uptake measurement. Three other methods were investigated: uptake was measured by quantitating the scans, neck content was determined before and after discharging the technetium from the thyroid with perchlorate, and uptake above background was derived from a linear scan. Good agreement was obtained, the last being adopted routinely as being the simplest method. (auth)

25936 ISOTOPE PLACENTOGRAPHY WITH ^{131}I-, ^{132}I-, ^{51}Cr-, AND ^{99m}Tc-LABELED HUMAN SERUM ALBUMIN. Deckart, H.; Herzmann, H.; Pockrandt, H.; Reichel, W. S. Strahlentherapie, Sonderbaende, 65: 37-45(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Localization studies of human placenta were performed in 130 cases using radioisotope labeled human serum albumin. Results were correct in 90% of all cases. The original method of Stern, McAfee et al., was modified to give a higher yield, since only 10 to 30% of the technetium becomes bound to the albumin when the original method was used. The metabolic behavior of the different radioalbumin preparations is discussed, and especially the instability of the ^{99}Tc human serum albumin complex. The advantage of the low radiation dose to mother and fetus when using ^{99}Tc labeled HSA for localization studies of the placenta is limited by the instability of the compound. Advantages and disadvantages of human serum albumin preparations labeled with chromium-51, iodine-131, iodine-132, or technetium-99 are discussed with reference to economy, shelflife, radiation dose, and minimal activity of tracer dose. (auth)

25937 INTEREST IN NUCLEAR INDICATORS OF SHORT PHYSICAL HALF-LIFE IN THE STUDY OF CARDIAC HEMODYNAMICS. de Vernejoul, P.; del Olmo, J.; Rangel-Abundis, A.; Kellershohn, C. (CEA, Orsay, France). Strahlentherapie, Sonderbaende, 65: 46-62(1967). (In French).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The usefulness of short lived isotopes in radiocardiography was investigated. Iodine-132 with a half-life of 2.26 hours, ^{123}I with a half-life of 25 minutes, ^{99m}Tc with a half-life of 6 hours, and ^{137m}Ba with the half-life of 2.6 minutes were examined. If ^{137}Ba is used millicurie amounts can be injected and this makes it possible to combine high sensitivity with extremely short time constants of the recording system. Furthermore, the high radio-

activity injected makes it possible to register the changes of activity not only over the heart region but also over the peripheral vessels. The increased precision of measurements and the possibility of measuring over peripheral vessels when using ^{137m}Ba as a tracer has made it possible to diagnose congenital heart failure with right to left shunts and aortic insufficiency. (auth)

25938 CLINICAL EXPERIMENTS ON THE USE OF ^{115m}In. Pal, I.; Gacs, J.; Toerkoe, J.; Farkas, G. (Univ., Budapest). Strahlentherapie, Sonderbaende, 65: 63-9(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

In an attempt to reduce the radiation dose to the patient in scintigraphic visualization of liver and spleen the 4.5 hour half-life radioisotope ^{115m}In was used. The ^{115m}In was separated daily from a generator of ^{115}Cd. An isotonic and sterile solution of indium hydroxid or indium EDTA, carrier free and with stable indium as a carrier, was used for these experiments. Organ distribution, blood clearance, and renal clearance of the tracer were determined and radiation dose to the critical organs was calculated. Normal and abnormal scintigrams of liver and spleen carried out with ^{115m}In as a tracer are shown. (auth)

25939 RECENT APPLICATIONS OF THE SCINTILLATION CAMERA. Anger, H. O.; Powell, M. R.; Van Dyke, D. C.; Schaer, L. R.; Fawwaz, R.; Yano, Y. (Univ. of California, Berkeley). Strahlentherapie, Sonderbaende, 65: 70-93(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The high sensitivity of the scintillation camera to γ rays of moderate energy and the favorable radiation dose characteristic of ^{99m}Tc make new dynamic studies of organ blood flow possible. Rapid intravenous injection of 2 to 10 mCi of pertechnetate and a continuous series of five second exposure scintiphotos as the isotope perfused the kidneys, heart, or brain of humans were used. These organ blood flow studies were correlated with static studies with other isotopic compounds. In some studies as many as three isotopes were imaged using pulse height selection to reject counts from previously injected isotopes. The technique is described in detail and clinical examples are shown. A sensitive positron scintillation camera with focusing capability was in operation for several years. It consists of an image detector with an 11.5 inch diameter by 0.5 inch thick sodium iodide crystal viewed by 19 photomultiplier tubes and a focal detector consisting of a nine inch diameter by 0.5 inch thick sodium iodide crystal viewed by seven photomultiplier tubes. The subject is placed close to the image detector and the focal detector is located a distance away on the opposite side of the subject. Positron emitters on any plane between the image detector and the focal detector can be brought into sharp focus on the resulting image. The positron camera was used to image the distribution of red cell forming marrow with ^{52}Fe, blood flow to bone with ^{18}F, and brain tumors with ^{68}Ga EDTA. It was also used to help locate the site of absorption of ^{52}Fe after oral ingestion. Tomographic operation of the positron camera, in which a series of planes within the subject are imaged in sharp focus, is described. A method for translating radiation intensity into color in a quantitative fashion is also described and recent examples are shown. (auth)

25940 IMAGING ^{99m}Tc COMPOUNDS WITH THE GAMMA SCINTILLATION CAMERA, AND THE USE OF THIS SYSTEM TO AVOID THE DISTORTION OF RESPIRATORY MOTION IN RADIOISOTOPE SCINTIPHOTOGRAPHY. Gottschalk, A.; Jiminez, F. F.; Lu, Chien-tai; Beck, R. N.; Harper, P. V. (Univ. of Chicago, Ill. Argonne Cancer Research Hospital, Chicago). Strahlentherapie, Sonderbaende, 65: 94-102(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The clean 140 keV γ of ^{99m}Tc is optimally suited for use with the gamma camera. Since the 0.51 inch × 11 inch sodium iodide crystal is 100% efficient for this gamma energy, a large number of dots can be accumulated rapidly; for example, the usual 2 to 3 mCi dose of ^{99m}Tc-sulfurcolloid for liver scanning yields count rates as high as 500,000 to 700,000 cpm, permitting excellent liver scintigraphs to be taken routinely in one minute or less. In addition, the high count rate permits adequate exposure while the subject holds his breath, thereby avoiding the respiratory motion artefact that decreases resolution by a factor of two. Lung, liver spleen, placenta, blood pool, bone marrow, kidney, and brain scintiphotographs are shown that demonstrate the excellent quality and reduced imaging time possible when the physical properties of ^{99m}Tc are combined with the imaging potential of the gamma camera. (auth)

25941 CLINICAL INVESTIGATIONS WITH THE SCINTILLATION CAMERA AND ^{99m}Tc. Scheer, K. E.; Jahns, E. Kazem, I.; Gelinsky, P. (Univ., Heidelberg). Strahlentherapie, Sonderbaende, 65: 103-15(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Technetium-99 is an ideal tracer for clinical studies with the Anger camera because of the high sensitivity of the camera for the γ energy of this isotope and the low radiation dose to the patient that permits the use of mCi tracer doses. There is an excellent uptake of pertechnetate in brain tumors. Results of about 50 examinations are reported. The quality of the camera photos is excellent when about 100,000 counts are used per exposure. Exposure time amounts to a few minutes. Since ^{99m}Tc is concentrated in the salivary glands (parotid, sublingual, and submandibular) they can be visualized. Furthermore, the stomach is easily depicted. If a 16 mm cine-camera with a speed of two frames per second is used, the passage of the technetium tracer through the right heart can be followed. Using ^{99m}Tc-labeled human serum albumin the interior of the heart may be visualized and after heat denaturation the compound may be used for producing images of the liver and lung. (auth)

25942 DETECTION OF RENAL BLOOD FLOW DISTURBANCES WITH RADIOISOTOPE METHODS IN CLINICS AND EXPERIMENTS. zum Winkel, K.; Hallwachs, O.; Gelinsky, P.; Schenck, P. (Universitaets-Strahlenklinik, Heidelberg). Strahlentherapie, Sonderbaende, 65: 116-22(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Renographic, conventional scintigraphic and camera scintigraphic studies in patients with renal artery stenosis and in dogs with unilateral experimental renal artery stenosis are reported. In 67% of the patients with renovascular hypertension the tracing of the renogram showed a delayed maximum over the diseased kidney and in 79% the initial spike was reduced (using a higher chart speed). Maximum activity and excretion phase were not altered characteristically. In the 13 dogs with experimental renal artery stenosis the initial spike and maximum activity were reduced in 92% and the excretion phase in 77%. Conventional scintigraphic studies showed a smaller kidney and occasionally an impaired uptake over the pathological side. Using the scintillation camera and intravenous injection of ^{131}I- hippuran, renal artery stenosis was visualized by a lower and later tracer uptake during the first circulation. Furthermore, bilateral and segmental impairment of blood flow and impairment of the blood flow by distopy of the organ may be visualized in camera studies. Thus the combined use of an isotope renogram and scintillation camera is a valuable complement to the conventional diagnostic methods in renovascular diseases. (auth)

25943 RAPID-SEQUENCE SCINTIGRAPHY OF THE KIDNEY: A NEW METHOD OF ESTIMATING FUNCTIONAL SYMMETRY. PHANTOMSTUDIES AND CLINICAL INVESTIGATIONS. Przedlacki, J.; Obara, R.; Toth, Z. (Dept. of Nuclear Medicine, Warsaw). Strahlentherapie, Sonderbaende, 65: 123-8(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

A method of rapid-sequence scintigraphy of the kidney is presented. The apparatus used was a conventional Siemens Nucleograph with a scanning speed of 120 to 180 cm/min and a size relation of object: image 1:2 or 1:3. The tracer used was hippuran labeled with iodine-125 or -131. The resolution of the apparatus was assessed by a study performed with a multi-chamber kidney phantom. The applications of, and the indications for rapid-sequence scintigraphy of kidneys in clinical diagnosis are discussed. (auth)

25944 QUANTITATIVE RENOGRAPHY AND APPRAISAL OF CIRCULATION OF EACH KIDNEY BY MEANS OF COMPARTMENTAL ANALYSIS AND THE USE OF DIGITAL COMPUTERS. Turco, G. L.; Ghemi, F.; Segre, G. (Univ., Turin). Strahlentherapie, Sonderbaende, 65: 129-35(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Iodine-131-hippuran was injected intravenously and recordings are obtained from three scintillation counters placed over the cardiac region and over the two renal regions. The activity of the tracer in blood and in the kidneys was thus recorded simultaneously. It is possibe to represent the system by a six compartment model. This is the simplest model that can account for the experimental data. In this model the dots indicate the com-

partments of blood, extravascular space, right kidney, and left kidney, and the arrows indicate transfer constants. The transfer constants from each compartment give the fractional amount of tracer that enters each kidney per minute and permits the circulation of each kidney to be assessed. The data obtained from each experiment are fitted to the model by the method of least squares and the transfer constants (and their standard deviations) are calculated by a digital computer (IBM 7094). This quantitative evaluation of renography is of help in the study of kidney diseases in man. (auth)

25945 A NEW APPROACH TO THE MEASUREMENT OF DIVIDED RENAL PLASMA FLOW BY ^{131}I-HIPPURAN AND EXTERNAL COUNTING IN HUMANS. Bianchi, C.; Coli, A.; Giannotti, P.; Lenaers, A. (Univ., Pisa, Italy). Strahlentherapie, Sonderbaende, 65: 136-44(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Despite the great number of techniques that have been proposed for the determination of unilateral renal blood flow, based on the Fick's or the Stewart-Hamilton's principles, only clearance measurements proved of clinical value. However, these methods do not represent an ideal procedure, since they require a double ureteral catheterization during PAH infusion, and can yield erroneous results owing to passage of urine out of the catheter into the bladder. In principle, the γ emission of ^{131}I-hippuran allows the measurement of the amount of tracer eliminated by the kidneys, without ureteral catheterization by means of external counting over each kidney. This estimate seems possible when urine flow into the bladder is stopped by external bilateral compression of the ureters when the build-up of the externally measured radioactivity is related to renal function. As plasma concentration is measured in a well type counter, it is necessary to correct the external counted value by means of a calibration factor. This can be obtained by removing the external compression on one side and collecting the urine from the bladder by a urethral catheter; or alternatively by measuring vesicle radioactivity after decompression as described in a previous report on the measurement of total renal clearance by external counting over the bladder. In order to obtain an efficient stoppage of urine flow into the bladder a special device was designed, using air compression that permits the maintainance of constant abdominal compression during the clearance period and the breaking of the compression alternately on each side. Good correlation was observed between the unilateral renal clearances measured by external counting of ^{131}I-hippuran and values obtained with the traditional technique of ureteral catheterization. (auth)

25946 BLOOD FLOW STUDIED BY FREELY DIFFUSIBLE RADIOACTIVE INDICATORS; DIAGNOSTIC APPLICATION IN PERIPHERAL ARTERIAL DISEASE. Lassen, N. A.; Garcia del Rio, H.; Gembicki, M.; Alpert, J.; Larsen, A. (Bispebjerg Hospital, Copenhagen). Strahlentherapie, Sonderbaende, 65: 145-52(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Freely diffusible (lipophilic), inert, radioactive tracers such as ^{85}Kr, ^{133}Xe, pass through the entire surface of cell membranes and probably reach a state very close to diffusion equilibrium between tissue and blood in a single passage through the capillary. Intra-arterial injection of such tracers combined with external recording over the tissue of their clearance allows the calculation of the mean transit time of the indicator. The blood flow, f, in ml/g/min is then given by $f = \lambda/t$, λ being the corresponding tissue blood partition coefficient. In the brain the t of both major tissue phases is obtained from t = area under curve/height of curve. In the myocardium and the kidney t of the quantitatively most important tissue component is best estimated from the initial slope of a logarithmic plot of the curve, i.e., $t = T\frac{1}{2}(\text{initial})/\ln 2$. Local injection of these tracers into a homogeneous tissue permits to be estimated from the slope of the tangent of the logarithmic presentation of the curve at any time, i.e., $t = T\frac{1}{2}$ (tangent)/ln 2. This approach is considered to be essentially valid in skeletal muscle, myocardium, myometrium, and adipose tissue. The diagnostic use of ^{133}Xe clearance studies in patients with occlusive arterial disease of the legs was demonstrated by a standarized walking test. All the affected legs showed an abnormally prolonged post-exercise hyperemic reaction. The blood flow in the abdominal subcutaneous fatty tissue was about 3.0 ml/100 g/min in normals and increases by about 100% after ingestion of a normal meal. The complex problems of applying the freely diffusible indicators to quantitative studies of cutaneous blood flow are discussed and the practical use of the qualitative studies with tracers of more restricted diffusibility (^{22}Na) is stressed. (auth)

25947 CUTANEOUS BLOOD FLOW IN MAN STUDIED BY FREELY DIFFUSIBLE RADIOACTIVE INDICATORS. Sejrsen, P. (Bispebjerg Hospital, Copenhagen. Municipal Hospital, Copenhagen). Strahlentherapie, Sonderbaende, 65: 153-61(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Radioautographic studies at the temperature of liquid nitrogen allow the evaluation of the distribution of radioactivity following intracutaneous injection of 0.1 to 0.01 ml of saline, containing ^{133}Xe. Initially a diffuse labeling of the entire thickness of the cutaneous layer was noted. After 20 to 70 minutes of in vivo clearance the remaining radioactivity was located mainly in the subcutaneous tissue. Externally recorded clearance curves after injection of from 0.1 to 0.003 ml intracutaneously showed an initial clearance rate which was more rapid than that obtained by subcutaneous injections, whereas after approximately 75 minutes the curves had almost the same clearance rate. It was possible by microdissection of the frozen tissue to obtain separate values for the activity in the cutaneous and subcutaneous compartments after intracutaneous injection. Accumulation curves for subcutaneous tissue were constructed from these studies. Mathematical analysis of the theoretical model enables the calculation of the cutaneous blood flow by graphical resolution of the clearance curve obtained by non-traumatic labeling of the cutis (epicutaneous application of ^{133}Xe. Intra-arterial injection of ^{85}Kr resulted in quite variable curves. Using this method a correction for diffusion is necessary. The epicutaneous ^{133}Xe method showed values for cutaneous blood flow ranging from 4.1 to 30 ml/100 g tissue/min. in normal man. For clinical studies the use of intracutaneous injections of ^{133}Xe together with histamine (to produce a reproducible degree of vasodilation) is suggested. (auth)

25948 ^{133}Xe CLEARANCE AS A MEASURE OF BLOOD FLOW THROUGH THE HUMAN MYOMETRIUM. Falk, V.; Forkman, B.; Lindell, S.-E. (Allmanna Sjukhuset, Malmo, Sweden). Strahlentherapie, Sonderbaende, 65: 162-5(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Munck et al. (1964), advocated ^{133}Xe as a better tracer than ^{24}Na for studies of blood flow through the uterine muscle since the former is freely diffusible in the tissues. Regardless of the tracer used, the blood flow calculated from the clearance rate shows great variation among normal cases. This variation was studied in relation to the site of the local injection of ^{133}Xe at laparatomy in connection with legal interruption of pregnancy. Xenon-133 was injected either through the abdominal wall or directly into the exposed uterus. After the measurement the uterus was opened and the distance from the site of injection to the placenta was noted. Injections distant from the placenta resulted in mono-exponential clearance curves M 7.7 ± 2.5 ml/min/100 g. Injections near the placenta resulted in a rapid phase of clearance curve 21.8 ± 8.5 followed by a slow part of clearance curve M 9.9 ± 3.1. The myometrium proper has a blood flow of about 9 ml/min/100 g. In the vicinity of the placenta this blood flow increases greatly. A comparison of myometrial blood flow measured from an injection made through the abdominal wall and injections made directly on the exposed uterus showed no significant differences. (auth)

25949 THE ^{133}Xe INHALATION TECHNIQUE FOR REGIONAL CEREBRAL BLOOD FLOW STUDIES. Veall, N.; Mallett, B. L. (Guy's Hospital Medical School, London). Strahlentherapie, Sonderbaende, 65: 166-73(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Measurement of the rate of clearance of ^{133}Xe from the brain by external counting following administration of the tracer by inhalation provides a simple, harmless technique for clinical studies on regional cerebral blood flow. However, the method is subject to considerable errors that had to be evaluated. A correction of about 40% must be applied to the observed clearance rate from the cerebral cortex to allow for the effects of arterial recirculation, but it was found possible to avoid the necessity for arterial blood samples by using an empirical correction derived from activity recorded in the expired air. This empirical correction procedure cannot be used in patients with impaired lung function. Analysis of the clearance curve into two components results in systematic under-estimates of the clearance rates from cerebral cortex and white matter, since there is a contribution from relatively poorly perfused extracerebral tissues. This effect can be eliminated by prolonging the period of observation and carrying out a three component analysis for the intracarotid injection method. However, this latter correction is probably un-

necessary in those applications where relative values are adequate. (auth)

25950 MEASUREMENT OF CEREBRAL FLOW BY ^{85}Kr. Lenaers, A.; van Thiel, E.; Cleempoel, H.; Kornitzer, M.; Stern, J. N.; Demeester, M.; Franken, L. (Univ., Brussels). Strahlentherapie, Sonderbaende, 65: 174-81(1967). (In French).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Cerebral blood flow was measured in 43 normal subjects and patients following administration of ^{85}Kr in the inspired air and using the continuous sampling technique. Contamination of the sampled venous blood by extracerebral blood was prevented by catheterization of the internal jugular vein in place of direct puncture of that vessel. In order to increase counting efficiency of ^{85}Kr in blood samples, a special apparatus was used, in which ^{85}Kr was counted in the gas phase. An analysis of the precision of the results is presented. (auth)

25951 RESULTS OF THE QUALITATIVE DETERMINATION OF CEREBRAL BLOOD FLOW. Wilcke, O. Strahlentherapie, Sonderbaende, 65: 182-91(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Cerebral blood flow was measured in patients with symptoms of arteriosclerosis or neoplasms using a tracer dose of 100 μCi ^{131}I-hippuran injected intravenously. Using four scintillation counters the circulation time of the brain and blood flow through the two hemispheres was measured. The circulation time and blood flow curves were altered by tumors causing increased intracranial pressure. The changes were to some extent dependent on the type of tumor. Prolonged circulation time and low blood flow tracings were typical for arteriosclerotic changes. Angiomas and carotid-sinus-cavernosus shunts caused shortened circulation time. The blood flow tracings, allowed these two diseases to be differentiated. Traumatic and other cerebral injuries gave characteristic pictures. The method can also be used for follow up studies. (auth)

25952 ^{86}Rb SINGLE INJECTION METHOD FOR THE STUDY OF THE CORONARY CIRCULATION IN MAN. Torreggiani, G.; Lenaers, A.; Federighi, G.; Menichini, G.; Bartolomei, G.; Donato, L. (Univ., Pisa, Italy). Strahlentherapie, Sonderbaende, 65: 192-6(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

A method for measuring coronary blood circulation in man by means of precordial counting after a single intravenous injection of ^{86}Rb or ^{42}K is described. The method has several potential advantages, namely the possibility of wide clinical application, since it does not require catheterization of the coronary sinus, and the fact that every volume unit of the myocardium, no matter how well perfused or by which way it is drained, contributes to the measured value. In consideration of its potential interest, it was thought advisable to compare the results of the ^{86}Rb single injection technique with those obtained by the nitrous oxide method and coronary sinus catheterization. Comparison of the values obtained with nitrous oxide with those derived from the ^{86}Rb single injection method showed a highly satisfactory agreement between the two techniques. This agreement of the two methods under the present conditions, and over the wide range of values explored, seemed to confirm previous conclusions concerning the adequacy of the ^{86}Rb injection method for measurement of coronary blood flow. (auth)

25953 PULMONARY REGIONAL BLOOD-FLOW AS EVALUATED BY MEANS OF ^{131}I TAGGED MACROAGGREGATED ALBUMIN (MAA-^{131}I). Meldolesi, U.; Martinenghi, C.; Tarolo, G. L. (Univ., Milan). Strahlentherapie, Sonderbaende, 65: 197-207 (1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

A radioisotopic method was developed for estimating regional pulmonary blood flow. This procedure is based on the analysis by means of scintiscanning, of the distribution of small radioactive pulmonary emboli, produced by intravenous injection of macroaggregated human ^{131}I-albumin (MAA-^{131}I). The method is very simple and well tolerated by patients and is, therefore, suitable for extensive clinical use. Some technical details are discussed together with the reliability of the information obtained, on the basis of investigations on MAA-^{131}I distribution in the human body. The diagnostic value of the method is also evaluated by considering the results obtained in the study of cases of various pulmonary lesions. (auth)

25954 BLOOD FLOW AND FUNCTION OF THE SPLEEN. Fischer, J.; Wolf, R. (Univ., Mainz). Strahlentherapie, Sonderbaende, 65: 208-24(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The blood flow of the spleen was estimated by using heat-treated ^{51}Cr-labeled erythrocytes for screening. The blood clearance curve was biphasic, since heat treatment produces two types of alteration: spherocytes of 5 μ diameter and fragments of erythrocytes of a diameter below 3 μ. In normal cases the blood clearance half-time for the spherocytes (about 70 to 80% of the preparation) is 4 to 5 minutes. Elimination of the spherocytes only occurred in the spleen, as shown by external counting. Measurement of the blood clearance of the spherocytes allowed splenic blood flow to be estimated. The results showed that blood flow through the spleen is much larger than was expected. The method may further be used to evaluate sequestration by the spleen, since in a number of diseases the capacity of the spleen for heat treated spherocytes is limited. Results of examinations in more than 1700 patients showed that such functional disorders of the spleen are demonstrated earlier by this method than using other diagnostic procedures. (auth)

25955 LOCAL BLOOD FLOW DISTURBANCES IN TIBIA FRACTURES INVESTIGATED WITH ^{131}I-HSA. Riccabona, G.; Philadelphy, G.; Vogl, W. (Univ., Innsbruck). Strahlentherapie, Sonderbaende, 65: 225-30(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Delayed consolidation of fractures of the leg are usually explained by an impaired circulation. To prove this hypothesis, the following method was used. Four minutes after intravenous injection of 100 μCi ^{131}I-labeled human serum albumin a profile count of the tibia was recorded using a scintillation counter with a slot collimator. The activity of both legs was recorded under similar conditions. This method does not allow a quantitative evaluation of local circulation but when the decrease of activity from knee to ankle is expressed as a percentage of the activity measured over the tibial tuberosity a significant difference of measurements between the control leg and the fractured leg was found in 30% of the cases. In this method only differences of at least 22% are significant, corresponding to differences in activity within the range of about 0.1 μCi per 2 cm. Clinical results obtained in 56 cases suggest that the method is only useful where the circulation is considerably impaired. (auth)

25956 ^{47}Ca METABOLISM IN CONGENITAL HEMOLYTIC ANEMIA (HOMOZYGOUS THALASSEMIA). Constantinides, C.; Binopoulos, D.; Drakos, C.; Malamos, B. (Univ., Athens). Strahlentherapie, Sonderbaende, 65: 420-9(1967).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

A two-compartment model and the Bauer method were used to describe kinetics of ^{47}Ca uptake in four cases of hemolytic anemia and seven normal subjects. The solution of the equations of the above kinetic system was performed on a high-speed digital computer, using the Berman (NIH-OMR SAAM) program. This program determined the sizes of the compartments and the transfer constants between them. Whole-body counting, plasma, urine, and feces data were utilized in this study for the determination of the sizes of bone compartments and the transfer rates between them, especially the accretion rate. In the hemolytic anemia patients, larger sizes for the exchangeable bone compartment and faster accretion rates were found. The primary advantage of the whole-body counter in this study lies in its ability to measure retention of tracer over a long period of time. With these long term data, it is possible to modify the modes appropriately in order to simulate resorption and long-term exchange and thus to make a better assessment of the kinetics of calcium metabolism. (auth)

25957 TESTING RENAL FUNCTION IN CASES OF URINARY TRACT DRAINAGE BY ISOTOPIC NEPHROGRAMM. Gasser, G.; Hawliczek, F.; Aberle, B. (Univ., Vienna). Strahlentherapie, Sonderbaende, 65: 475-9(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

The radioisotope nephrogram is ideally suited for repeated assessment of renal function in cases with permanent drainage of the urinary tract. (auth)

25958 EXPERIENCE IN THE DIAGNOSTIC USE OF NEW MERCURY-LABELED COMPOUNDS. Herzmann, H.; Loechel, M.; Schwartz, K. D. (Univ., Rostock, Germany). Strahlentherapie, Sonderbaende, 65: 480-4(1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

Hydroxymersalyl (2-(3'-hydroxymercuri-2'-hydroxypropylcarbamyl)-phenoxyaceticacid-Na) labeled with mercury-203 may be used advantageously for renal scintigraphy. In comparison with the conventionally used Methoxycompounds, Hydroxymersalyl shows higher uptake and retention in the kidney. Liver uptake of the compound is comparatively low. It is, therefore, suitable for renal scintigraphy and it is superior to Neohydrin, since excretion is faster than this compound. (auth)

25959 III. SYMPOSIUM DER ARBEITSGRUPPE NUKLEARMEDIZIN IN DER MEDIZINISCH-WISSENSCHAFTLICHEN GESELLSCHAFT FUER ROENTGENOLOGIE DER DDR, DRESDEN, VOM 9.-11. JUNI 1966. (Third Symposium of the Work Group on Nuclear Medicine in the Medical-Scientific Society for Roentgenology of the GDR, Dresden, June 9-11, 1966). Rossendorf, Ger., Deutschen Akademie der Wissenschaften zu Berlin, 1967. 181p. (CONF-660659).

Thirty-one papers discuss techniques for clinical diagnosis using radioisotope tracers, the efficiency of scintillation detectors and γ cameras for scintiscanning, the diagnostic value of color scintiscans, whole-body counting techniques, and the use of ^{198}Au colloids and seeds for the treatment of neoplasms. One paper is abstracted concerning the effects of tissue attenuation on the radiation dose to fetuses during radioisotope placentography. (C.H.)

For an abstract of the individual paper see: 25960.

25960 INCORPORATION OF TISSUE ABSORPTION IN THE CALCULATION OF THE RADIATION BURDEN OF FETUSES IN ISOTOPE PLACETOGRAPHY. Tautz, M. (Radiologische Klinik des Staedtisches Klinikums, Berlin). pp 97-103 of III. Symposium der Arbeitsgruppe Nuklearmedizin in der Medizinisch-Wissenschaftlichen Gesellschaft fuer Roentgenologie der DDR, Dresden, vom 9.-11. Juni 1966. Rossendorf, Ger., Deutschen Akademie der Wissenschaften zu Berlin, 1967. (In German).

From 3rd Symposium of the Work Group on Nuclear Medicine, Dresden. See CONF-660659.

In the calculation of the radiation burden of fetuses in isotope placentography the tissue attenuation of the γ radiation was neglected. The effect that the introduction of this attenuation would have on the calculated radiation burden was evaluated using the theory of moment integrals. The dose reduction produced by the attenuation effect was calculated numerically for some specific examples. (J.S.R.)

Radiation Effects on Animals

Refer also to abstracts 25253, 25254, 25711–25714, 25721, 25723, 25726, 25737, 25740, 25741, 25746–25750, 25753, 25755, 25758, 25763, 25766, 25768, 25771, 25785, 25786, 25796, 25800, 25804, 25815, 25818–25821, 25825, 25831, 25832, 25835, 25841, 25859, 25861, 25863, 25864, 25869, 25875, 25876, 25879, 25882–25885, 25887–25890, 25892, 25894–25900, 25909, 25910, 25914, 25921, 25927, and 25960.

25961 (BNWL-531-2) INDUCED RADIONUCLIDES IN ASTRONAUTS. Quarterly Activity Report No. 2, October 1, 1967–January 1, 1968. Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 12, 1968. Contract AT(45-1)-1830. 18p. Dep. CFSTI.

Tissue equivalent solutions containing H, O, C, N, Na, K, Cl, Rb, and Cu near the concentrations present in a standard man were prepared and placed in lucite target boxes. The solutions were irradiated with protons and fast and thermal neutrons. The experiments were designed to measure radioinduced activity in tissue media of known elemental concentration and changes in radionuclide production rate as the proton beam was degraded through a tissue equivalent material. For studies on irradiation of tissues, homogeneous material was obtained by triple grinding of beef muscle. Aliquots of tissue were analyzed for trace elements by neutron activation. The tissue was irradiated with protons. It was demonstrated that the production of ^{7}Be and ^{24}Na from proton irradiation was a function of depth through muscle tissue media. Sodium-22 was also produced from proton irradiation. In a flight in an Air Force plane at 60,000 to 63,000 ft., sodium fluoride monitors were placed at various locations on the pilot and in the fuselage of the aircraft. An aluminum monitor was located in the fuselage of the aircraft. The sodium fluoride served as a flux monitor for thermal neutrons and the aluminum monitor served as a measure of fast neutrons. The observed neutron fluxes from these monitors are tabulated. Flux monitors were placed on the thigh and ankle of both pilot and navigator. The results showed that the neutron flux at the surface of the pilot was three-fold higher than that on the navigator. (H.L.W.)

25962 (COO-119-236) RESEARCH IN RADIOBIOLOGY. Annual Report. Dougherty, Thomas F. (Utah Univ., Salt Lake City. Radiobiology Div.). Mar. 31, 1967. Contract AT(11-1)-119. 268p. Dep. CFSTI.

Radium-226, Plutonium-239, Radium-228, Thorium-228, Strontium-90, Radium-224, Americium-241—toxicity in dogs, clinical and pathological aspects of

Diseases, Neoplastic, Diseases, Physiological, Diseases, Traumatic, Diseases, Infectious—incidence in dogs following injection of α, β, or γ emitting isotopes

Metabolism—americium, in beagle dogs

Hormones, Sex—androgen, radiation effects on synthesis of, in dogs, internal ionizing

Enzymes—radiation effects on, in blood serum of dogs, americium-241 and plutonium-239 α, β, and γ

Cesium-137, Potassium—content of man with muscular dystrophy

Diseases, Neoplastic—melanomas, growths of implanted, in mice, effects of diet and drugs on (B.S.L.)

25963 OCCUPATIONAL CARCINOGENESIS. Boyland, E. (Royal Cancer Hospital, London). Practitioner, 199: 277-84 (Sept. 1967).

Ionizing radiation and other physical and chemical agents acting as carcinogens in workers exposed to these agents are reviewed. The first industrial hazard causing respiratory cancer to be recognized was the Bergsucht, or mountain disease, of the Schneeberg miners in the Erzgebirg of Saxony. The mines were originally worked for Fe and Cu and later for Ag, Zn, Pb, Mn, Mg, Bi, As, Ni, and Co. When the disease was first recognized as lung cancer in 1879, the radioactive nature of the ores in these mines was not known. The incidence of lung cancer in the Schneeberg miners was almost 50 times as high as that among males in Vienna. It is now accepted that the lung cancer was due to Rn and other radioactive materials in the air of the mines. Lung cancer as an occupational disease was also seen in fluorspar mines in Canada and in U mines in Colorado, South Africa, and Joachimsthal. The increasing demand for U had necessarily increased the working of U mines but the recognition of the hazard made it possible for the exposure of miners to radioactive material to be kept below dangerous levels. (BBB)

25964 EFFECT OF NATURAL RADIOMIMETICS, IONIZING RADIATION, AND VIBRATION ON VARIATION IN THE LEVEL OF HISTAMINE IN RAT TISSUES. Bulushi, S. G.; Goncharenko, E. N.; Kudryashov, Yu. B. Nauch. Dokl. Vyssh. Shk., Biol. Nauki, No. 1, 87-9(1966). (In Russian).

Results of experiments for verification of a hypothesis that the histamine content of animals varies as a result of natural radiomimetics, toxic substances formed as a result of radiation, and results of a study of the comparative effect of various agents (natural radiomimetics and radiation and vibration) on variation in the content of free histamine in animal tissues are presented. Preparations of natural radiomimetics evoked reliable changes in the content of free histamine in the tissues studied: skin, kidneys, and liver. These changes were phased; in the initial period of injury, after injection of natural radiomimetics, there was a sharp increase in histamine content, and in the terminal period there was a drop in the free histamine level below the norm. There was a similarity in dynamics of the free histamine level as a result of natural radiomimetics, the oxidation products of oleic acid, and ionizing radiation. It was found to be experimentally possible to increase the histamine content in animal tissues with natural radiomimetics. Vibration was also capable of causing a change in the free histamine level. The increase that resulted from the vibration was brief and the norm was subsequently reestablished. (JPRS)

25965 HIGHER NERVOUS ACTIVITY IN RATS IRRADIATED WITH X RAYS AT DIFFERENT PERIODS OF POSTNATAL DEVELOPMENT. Novakova, V.; Sterc, J. (Inst. of Physiology, Prague). Physiol. Behav., 2: 421-3(Oct. 1967).

Late effects of ionizing radiation on higher nervous system activity in adult rats were described. Low doses were used in a chronic experiment because such doses were of greater practical significance than higher ones. Adult male rats were irradiated at the ages of 10, 15, 25, 30, and 90 days at a dose of 50 R over the head. The conditioned reflexes of rats irradiated on days 10, 15, and 30 postnatally developed more slowly than those of both control rats and animals that were irradiated when adult (90 days) or when 25 days of age. Rats irradiated on day 25 or 90 did not

differ from control animals. Existence of a period of increased sensitivity to ionizing radiation in the suckling period was demonstrated. Irradiation at very low doses (0.2% of LD_{50}) at the period of increased sensitivity considerably altered the adaptive ability towards the environment in adult animals. (BBB)

25966 EFFECTS OF IONIZING RADIATIONS ON THE HYPOPHYSIS-ADRENAL SYSTEM IN MAMMALS. Tachi, Chikashi (National Inst. of Radiological Sciences, Chiba, Japan). Jikken Keitaigakushi, 16: 22-31(Oct. 1962). (In Japanese).

The effects of radiation on the pituitary and the adrenal gland, particularly the adrenal cortex, and the influence of hormones from these glands on the radiation syndrome are reviewed. Radiation effects, as both a specific and nonspecific stress, on the hypophyseal-adrenal histologic and endocrine reactions are considered. Extensive studies, performed on hydroxycorticosteroid and ketosteroid levels in blood and urine after irradiation, demonstrated the intervention of adrenocortical secretions in the radiation syndrome. On the other hand, unequivocal beneficial effects of corticosteroid hormones or of ACTH on radiation disease were not demonstrated. In fact, cortisone, just as ionizing radiation, had injurious effects on lymphocytes. Changes in electrolyte blood levels and excretion patterns, especially Na and K, also reflected radioinduced effects in the pituitary-adrenal interaction. (64 references) (BBB)

25967 PRESENT STATE AND OUTLOOK FOR USE OF ULTRAVIOLET IRRADIATION IN PREVENTING SUNLIGHT DEFICIENCY. Gorkin, Z. D.; Dantsig, N. M. Vestn. Akad. Med. Nauk SSSR, No. 8, 58-62(1968). (In Russian).

On the basis of numerous studies, the Ministry of Health made recommendations for the use of ultraviolet irradiation to prevent sunlight deficiency. Two systems of erythematic uv irradiation were considered: namely long-term and short-term action. In the long-term program, persons were uv-irradiated over a long period at a relatively low rate. Mercury-quartz lamps were used in combination with longwave uv irradiation of erythematic luminescent lamps. In the short-term program, persons were exposed to intensive uv irradiation for only a few minutes. To avoid overexposure, permissible minimal and maximal doses for an 8-hr period were established. The smallest dose should not be lower than 1/8 of a biodose (10 M. E. D./hr/m^2) and the largest dose should not exceed 3/4 of a biodose (60 M. E. D./hr/m^2). Use of 1/2 a biodose was recommended. Respectively, irradiation should not be lower than 1.5 M. E. D./m^2 and not higher than 7.5 M. E. D./m^2; the recommended dose was 5 M. E. D./m^2. Ultraviolet irradiation was recommended for underground mining operations, industries located in windowless buildings, and children in the north. Prophylactic uv irradiation should be conducted in the fall, winter, and spring, and duration of irradiation depended on climate light conditions. Thus, the period extended from 1 Oct to 1 Apr for northern latitudes, from 1 Nov to 1 Apr for temperate latitudes, and from 1 Dec to 1 Mar for southern latitudes. With the widespread introduction of prophylactic uv irradiation in industry and institutions, the development of safety standards assumed greater importance. (ATD)

25968 CLINICAL COURSE OF ACUTE RADIATION SICKNESS IN PIGS. Pawel, Otto; Kalousova, Vilma; Vranovska, Jirina (Veterinary Research Center, Prague). Voj. Zdravot. Listy, 35: 263-7(Dec. 1966). (In Czech).

Pigs were subjected to whole-body radiation with doses of 450, 700, and 1000 R (^{60}Co γ). Radiation sickness developed after irradiation with 700 R. During the second and third weeks following irradiation, maximum development of the clinical aspects of the disease was observed; most of the animals died then. Clinically, the sickness was characterized by hemorrhagic diathesis, changes in body temperature, and loss of weight. (TSS) (JPRS)

25969 STUDY OF THE EFFECTS OF SINGLE DOSE X-RADIATION OF LIVER IN ALBINO RATS. Agrawal, S. K.; Mehrotra, R. M. L. (Medical College, Lucknow, India). Indian J. Pathol. Bacteriol., 9, 175-8(1966).

Histological and biochemical changes in the livers of animals exposed to a single dose of 3000 and 25,000 R were investigated. After irradiation with a dose of 3000 R minimal evidence of hepatic injury characterized by focal necrosis and fenestration of cytoplasm of the liver cells was seen in a few animals at 24 hr. At later intervals there was no evidence of histologic liver damage. Animals irradiated with a dose of 25,000 R and killed at five and ten days interval, showed a narrow zone of subcapsular necrosis of the liver on the irradiated surface. The deeper portions of the parenchyma did not show any morphological changes. There was an increase in wet liver wt. and water content, and alterations in nitrogen, glycogen, and lipid contents at various periods. (auth)

25970 DISTURBANCE OF AROMATIC AMINO-ACID EXCHANGE PRODUCTS EXCRETED WITH URINE IN PERSONS EXPOSED TO THE ACTION OF VIBRATION AND UHF ELECTROMAGNETIC WAVES. Manyashin, Yu. A. Gig. Tr. Prof. Zabol., No. 8, 47-9(1967). (In Russian).

The effects of vibration and UHF electromagnetic waves on the exchange of aromatic amino acid products were investigated. Three groups of persons were studied: the first group consisted of 31 patients with vibration disease in stages I, II, and III; the second group consisted of 20 persons exposed to UHF electromagnetic waves of relatively low intensity (most often less than 15 to 20 $\mu w/cm^2$); the third group consisted of 28 healthy persons. Phenols were determined in daily urine specimens according to Yu. I. Shillinger and N. V. Orlova's method based on interaction of phenols with denitrogenized p-nitroaniline, and separation of free, total, and bound phenols was measured with a photoelectrocolorimetric method. For a more detailed investigation of phenol characteristics, K. P. Villako's method (not described) was used to determine ether-insoluble phenol substances (tryosin, tyramine, and adrenalin), aromatic hydroxy acids, and volatile phenols. Findings showed that excretion of all phenols except bound phenols was significantly increased in patients with vibration disease and persons exposed to UHF electromagnetic waves. With more detailed study, it was found that the increase of phenols excreted with urine in vibration disease patients correlated directly with the degree of illness. This dependence was most markedly expressed by ether-insoluble phenol substances and aromatic hydroxy acids, that is, by substances least related to decomposition processes in the intestine. With persons exposed to UHF electromagnetic waves, dependence of phenol increased and the clinical picture was not as clearly marked. The exchange of aromatic amino acids was disturbed by vibration and UHF electromagnetic waves as demonstrated by the increased excretion of phenol products. (auth)

25971 EFFECT OF PLUTONIUM ON THE CONCENTRATION OF NUCLEIC ACIDS IN THE BONE TISSUE OF RABBITS. Dibinzon, R. E.; Yelkina, N. I. Vop. Med. Khim., 12: 487-92(Sept.-Oct. 1966). (In Russian).

The effect of ^{239}Pu on the concentration of nucleic acids in bone tissue was studied. The experimental animals were gray rabbits of both sexes with an initial weight of 1.7 to 2.2 kg (3 to 3½ mo of age). The plutonium was introduced in a single injection of nitrate solution in quantities of 2 and 7 μCi/kg of body weight. The animals injected with 7 μCi/kg were killed 7, 14, 30, 90, 135 and 180 days after injection, while those injected with 2 μCi/kg were killed after 90, 180, 270, 365 and 545 days. The epiphyseal, metaphyseal and diaphyseal parts of the long bones and vertebrae were frozen, ground and passed through a sieve. This bone meal was then treated to remove minerals and tested for DNA and RNA concentration. The resultant data were statistically analyzed. The results showed that the nucleic acid concentration in the bone tissue of the experimental animals was considerably lower than in other tissues. The epiphyseal-metaphyseal sections of long bones and vertebrae contained considerably more nucleic acid than the diaphysis. There was a considerable reduction in DNA concentration in the bone tissue after injection of ^{239}Pu, particularly in spongy bones. The effect of the radioisotope on RNA concentration in bone tissue was not as pronounced as in the case of DNA, with practically no deviation from the normal concentration when the dose was reduced. The concentration of DNA and RNA in osteosarcomas was considerably higher than in the bone tissue of tumor-bearing animals. (JPRS)

25972 THE PROBLEM OF AUTONOMIC AND CARDIOVASCULAR DISORDERS DURING THE CHRONIC ACTION OF SHF ELECTROMAGNETIC FIELDS. Drogichina, E. A.; Sadchikova, M. N.; Snegova, G. V.; Konchalovskaya, N. M.; Glotova, K. V. Gig. Tr. Prof. Zabol., No. 7, 13-17(1966). (In Russian).

One hundred subjects (73 men and 27 women aged 21 to 40) were examined over a period of 10 years. These persons were chronically exposed to the influence of microwaves (intensity up to a few mw/cm^2) and showed some pathological conditions. Light asthenic and autonomic vascular shifts were characteristic in 39 subjects with initial stages of microwave pathology. Pathological deviations in cardiac function were not noted in these subjects. Of 61 subjects with moderate and pronounced microwave symptoms, the angiodystonic syndrome and pronounced instability of autonomic vascular reactions (predominant hyperreactivity, pulse and arterial pressure lability) were noted. Tachycardia was detected in 16 subjects (90 beats/min or more), and bradycardia in 19 (about 60 beats/min). Capillaroscopy revealed a tendency towards atonic spasm. Constriction of the retinal artery was also noted. The majority of subjects complained of pain in the cardiac region. Most of the changes observed were unstable and with few exceptions disappeared after one to two weeks. Two case histories of

coronary patients who had been chronically exposed to SHF were presented. In general, these observations showed that upon treatment and release from exposure conditions, functional changes in the nervous system steadily decreased. Autonomic vascular changes were the most persistent symptoms of chronic exposure to SHF. Otherwise, angiodystonic manifestations coupled with EKG changes were pronounced for two to three years after curtailment of work around SHF sources. Thus, clinical observations of subjects chronically exposed to SHF indicated that angiodystonic pathology could eventually aggravate the development of more severe autonomic and cardiovascular pathology. A pronounced SHF effect was characterized by angiodystonic disorders, diencephalic disturbances, and coronary spasms. (ATD)

25973 DEVELOPMENT OF ATYPICAL ADENOMAS IN THE THYROID AS A LATE SEQUEL OF THERAPY WITH ^{131}I. (REPORT ON OPERATIONS). Zukschwerdt, L.; Bay, V.; Gusek, W. (Univ., Hamburg). Med. Welt, No. 15, 745-51 (Apr. 9, 1966). (In German).

Six cases of atypical thyroid adenomas, or low-grade carcinomas, observed one to five yr after treatment with from 3.5 to 7 mCi of ^{131}I for various thyroid disorders were reported. The ages of the patients ranged from 29 to 53 yr. Preoperatively, all patients had solitary or multiple cold nodules. The histological findings included atypical, essentially follicular adenoma, giant-cell trabecular adenoma, cystic adenoma, and definitely regressive changes in the thyroid tissues. The pathogenesis of the adenomas was discussed. It was concluded that hot nodules should be removed surgically. The low degree of malignancy of the carcinomas and malignant carcinomas that occurred after radioresection of the thyroid demanded conservative treatment, such as the unilateral removal of the thyroid. All operations performed after radioresection of the thyroid required intraoperative histological study. (BBB)

25974 HYPERTHYROIDISM. Greer, Monte A.; McDonald, Martha W. Disease-a-Month, 1-45 (Oct. 1967).

Various aspects of hyperthyroidism are reviewed, including treatment with radioiodine and occurrence and prevention of late radiation effects, such as hypothyroidism. Calculation and selection of optimum dose to prevent such late effects were discussed. Since the greatest variation was in the biologic response of the patient's thyroid gland, such calculations were crude, at best. A formula of administering a dose of ^{131}I calculated to deliver 100 μCi/g to thyroid tissue was applied, using an estimate of the size of the thyroid gland obtained by palpation. The required quantity of ^{131}I in mCi was calculated by dividing the estimated weight of the thyroid gland by the percent accumulation of a previous tracer dose of radioiodine by the thyroid gland at 24 hr and an appropriate correction factor. It was unwise to re-treat a patient who maintained some degree of hyperthyroidism before three months had elapsed following ^{131}I therapy, because of the progressive damage from radiation. At the end of three months, if hyperthyroidism still persisted, treatment with a further dose of radioiodine should not be given if the radioiodine uptake at that time was low (below 20%). Hyperthyroidism existing in the presence of such a low uptake at three months post-therapy usually indicated that the gland had been severely damaged by radiation. A remission had not yet been achieved because some preformed thyroid hormone was still being released by the irradiated gland. A euthyroid state almost always followed within a month or two under such circumstances, and could progress to hypothyroidism. By use of small doses, repeated, as necessary, every one to three months, or combined with antithyroid drug therapy, the incidence of late-developing myxedema could be reduced. The question of whether only patients over a certain age limit should be treated with ^{131}I was discussed in terms of various hazards. Since there was no evidence that any serious complication other than myxedema followed radioiodine therapy, it was concluded that the dangers from ^{131}I were considerably less than those from surgery in the younger age group. However, its use was not recommended in women who were pregnant at the time of therapy or within the first two to three years of life because of the apparent risk of subsequent cancer of the thyroid in infants irradiated in the thyroid region. (BBB)

25975 ANIMAL EXPERIMENTS ON THE INDUCTION OF INTRACRANIAL TUMORS BY IONIZING RADIATION. Jaenisch, W.; Kirsch, M. (Pathologisches Institut, Erfurt, Ger.). Exp. Pathol., 1: 226-33 (1967). (In German).

Induction of mesenchymal intracranial tumors by intensive irradiation of the head was studied in 88 mice, guinea pigs, rabbits, and ferrets with subdurally or epidurally implanted radioactive seeds of ^{198}Au. The implanted sources varied from 0.135 to 37 μCi in activity, giving doses between 270 and 120,500 rad at a distance of 2 mm and 108 and 15,600 rad at 5 mm. After six months 59 animals were dead. In all the other animals that received doses of 5000 rad and higher at a distance of 5 mm it was possible to find distinct necroses in brain tissue after six to eight days. During the first month of irradiation, in the area of the necroses, no marked reaction in connective tissue or glia could be observed. In necroses of the outer skin, secondary infections occurred. By application of lower doses (1000 to 4900 rad) development of less distinct necroses could be observed. A total of 29 animals survived during the experiment for more than six months. The findings were discussed in terms of four categories: necroses or cysts with glial reactions, formation of glial or connective tissue-like scars, marked glial proliferation in irradiated sites (guinea pig and rabbit), and no observable radiation effect (seven animals). The extended glial proliferations were not regarded as tumors. Existing reports on experimental induction of brain tumors by irradiation are critically discussed and compared with the present findings. (BBB)

25976 SUPERFICIAL X-RAY CAUTERIZATION. Bachurzewski, J. (Univ. Medical School, Warsaw). Z. Haut- Geschlechtskr., 42: 105-8 (Feb. 15, 1967). (In German).

Treatment of 132 epitheliomas with a single dose of 2000 to 3000 R of soft Grenz x irradiation produced moderately erythemic skin reactions. After 2000 R was given daily for two days to nine patients, one reacted with exudative erythema, and another reacted with separation of the epidermis. Final cosmetic results were very good, however. After a single dose of 2000 to 3000 R of filtered 20-KV x irradiation for treatment of 12 epitheliomas, only one severe reaction was observed. In some of the patients the edges of the irradiated skin site were hyperpigmented for as long as a yr. after irradiation. When 28 cases of epitheliomas were each irradiated with 1500 to 2000 R of soft x rays over a period of two days, eight showed severe skin reactions, and ten reacted with epidermal separation. A very severe reaction was observed when the epithelioma was located on the neck or on the side of the rib cage, particularly if the diameter of the tumor was greater than 5 cm. In treatment of 12 cases of senile keratoses of the face, 1500 R of soft x irradiation was administered daily for two days. The tissue half-value depth was 3 mm. Because of the small dia. of the tumors the irradiation reactions were severe. However, only one patient showed an exudative reaction. (BBB)

25977 PROBLEMS POSED BY A LATE CERVICAL RADIONECROSIS AFTER SURGERY. Martin, H.; Gignoux, M.; Cajgfinger, H.; Lapicorey, P.; Bertoin, P. Rev. Laryngol., Otol., Rhinol., 85: Suppl., 907-9 (Oct. 1964). (In French).

Cutaneous necrosis following radiotherapy is discussed in terms of a case study. The patient received postoperative irradiation (45 sessions) after an epiglottectomy for epithelioma of the epiglottis. Two years later the appearance of an enlarged cervical lymph node necessitated surgery, followed by irradiation in 34 fractions with a dose of 300 R each. After 12 years a small ulcer appeared on the scar of the incision. Several treatments were tried without success, such as local application of ointments with a base of placental extract, vitamins, fresh placenta, and antibiotics. After five months, the wound increased to the size of a quarter and extended toward the carotid region. A Dakin wet dressing produced a cleansing but not a healing effect. General characteristics of radioinduced dermatitis are discussed, and the cellular and vascular effects stressed. In the case presented, the predisposition to radiodermatitis was increased by the fact that two incisions had been made which caused the skin vasculature to be interrupted. Plastic surgery was performed on the affected area and a pectoral flap was used to repair the tissue. The importance of the pectoral flap graft was stressed; its thickness and vascularization allowed rapid healing when it replaced the devitalized skin. (BBB)

25978 SYNERGISM OF IRRADIATION, TOURNIQUET INJURY, AND DRUM TRAUMA: EFFECT OF REGIONAL SHIELDING. Nagler, Arnold L.; Levenson, Stanley M. (Yeshiva Univ., New York). Amer. J. Physiol., 214: 659-64 (Mar. 1968).

The lethality of various forms of trauma is increased for animals previously exposed to whole-body x irradiation. The effects of Pb shielding of specific regions of the animals during irradiation on this synergism were studied. Sublethally irradiated mice were markedly susceptible to tourniquet injury 8 to 12 days after x irradiation but not before or after this period. This synergism was not the result of a caging effect but could be prevented by lead shielding of various regions of the body during irradiation. Shielding of the mid one-third of the body was particularly effective. Whole-body x irradiation of rats predisposed them to the lethal effects of drum trauma beginning one hr after irradiation and continuing throughout the 30-day experimental period; maximum susceptibility was 6 to 14 days after irradiation. This syner-

gism was also markedly diminished by mid one-third body shielding during x irradiation. Drum trauma did not predispose rats nor did tourniquet injury predispose mice to the lethal effects of whole-body x irradiation one hr to 30 days later. (auth)

25979 Na, K, AND H_2O IN X IRRADIATION AND TOURNIQUET INJURY: ASSAY, SHIELDING, AND THERAPY. Nagler, Arnold L.; Levenson, Stanley M. (Yeshiva Univ., New York). Amer. J. Physiol., 214: 665-71(Mar. 1968).

Mice exposed to whole-body x irradiation were subjected to tourniquet injury of their hindlimbs 5 and 10 days later. The shifts of water, sodium, and potassium were measured 4, 8, and 16 hr following tourniquet injury. The major quantitative changes were proportionate shifts of sodium and water into the injured caudal half of the carcass, principally from the visceral component. Increases of potassium in the cephalad half of the carcass and corresponding decreases in visceral potassium occurred. These shifts were not altered by shielding of various regions of the body during irradiation, and in fact, were the same in unirradiated mice subjected to tourniquet injury. These changes were not correlated with survival or death. Intraperitoneal sodium chloride (0.85%) was not effective in preventing death of unshielded irradiated mice subjected to tourniquet injury. This lack of benefit of sodium chloride could not be explained by differences in absorption rates. Other factor(s) in addition to the shifts of water, sodium, and potassium underlie the increased lethality of tourniquet injury for irradiated mice. (auth)

25980 EFFECT OF LOW DOSES OF γ-RAYS ON SOME BIOCHEMICAL INDICATORS OF INCUBATED EGGS. Naydenskii, M. S. Tr. Mosk. Vet. Akad., 49: 225-31(1966). (In Russian).

The effect of γ rays from uranium salts on the sugar level in egg plasma, glycogen of the yolk, and embryonic liver as well as catalase levels of embryo blood and egg plasma was studied. Low doses of γ radiation (total dose 1.4 R) increased the catalase activity in the blood of chick embryos by the 12th day and decreased it in the second half of the incubation period, not only in the blood but also in the yolk. During irradiation the glycogen synthesis increased in the yolk and embryonic liver. It was concluded that low doses of γ radiation played a favorable role in incubation of eggs. (ATD)

25981 EFFECT OF WHOLE BODY IRRADIATION ON SPONTANEOUS MOTILITY OF RAT ISOLATED DUODENUM AND ITS CONTRACTILE RESPONSE TO ACETYLCHOLINE AND 5-HYDROXYTRYPTAMINE. Quastel, M. R. (Hebrew Univ., Jerusalem). Brit. J. Radiol., 41: 142-6(Feb. 1968).

Isolated duodenal segments, obtained from rats exposed one to three days previously to 1,000 R whole-body x irradiation, had increased average amplitudes of contraction compared to non-irradiated controls. Gut obtained from rats exposed to 500 R and 1,000 R showed an apparently normal response to acetylcholine but a diminished contractile response to serotonin. The period of regrowth of the mucosal epithelium four to six days after 500 R corresponded to a partial or complete recovery in the response to serotonin. These results suggest that an altered intestinal serotonin response, possibly associated with mucosal damage, must be considered in the etiology of gut motility changes during the acute radiation syndrome. (auth)

25982 TRANSPLANTATION OF CELLS TO IRRADIATED RECIPIENTS AS A PATTERN OF BIOLOGICAL INVESTIGATION. Petrov, R. V. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 766-80(1967). (In Russian).

The article presents a survey of the literature from 1951 to 1967 on the use of irradiated animals as test-tubes (cultivation in vivo) that consists of obtaining cells from a donor, transplanting them to a lethally irradiated recipient, and estimating the vital activity in the recipient. It permits studying the direct action of different types and doses of radiation, and radioprotectors. Radiation-induced inactivation of antibody formation also has been investigated. The purpose of the article was to attract the attention of investigators to a promising method which has developed within the framework of radiobiology. (32 references.) (JPRS)

25983 OCCUPATIONAL SKIN DISEASES CAUSED BY IONIZING RADIATION. Karcher, K. H. Arbeitsmed.-Sozialmed.-Arbeitshyg., 1: 411-16(Dec. 1966). (In German).

After briefly referring to the history, uses and hazards of x rays and the purpose and content of the West German Radiation Protection Ordinance, the author gives a description, with numerous illustrations, of two acute radiation accidents. The first involved a 37 year old electronics engineer who received a radiation dose to the fingertips of about 20,000 R; in the second, a 39 year old physicist received a dose estimated at about 10,000 R in the right hand. Whereas in the latter case the skin injuries healed completely in 2 months, without skeletal changes, the former was complicated by severe ulcerative changes in the extremities of the fingers. Possible methods of treatment are discussed. (auth)

25984 RADIOSENSITIVITY OF A SERIES OF CULTURED PRIMARY FIBROSARCOMATA. Madoc-Jones, H.; Dawson, K. B.; Field, E. O. (Royal Marsden Hospital, Surrey, Eng.). Radiology, 90: 541-6(Mar. 1968).

Survival curves following x irradiation were obtained for cells in primary culture derived from 15 benzpyrene-induced rat fibrosarcomata. Their D_0 values varied from 81 to 737 R. In one case, a cell population of mixed radiosensitivity was observed in which the radioresistant fraction finally outgrew the radiosensitive. Some of the difficulties in interpreting such experiments with primary cultures are discussed. These findings make it unlikely that cells cultured from biopsy material of solid tumors may be employed to predict the response of a tumor to radiation. (auth)

25985 EFFECT OF IRRADIATION OF METACERCARIAE ON THE SUBSEQUENT MORPHOGENESIS OF FASCIOLA HEPATICA IN ALBINO MICE. Movsesijan, M.; Sokolic, A.; Sibalic, S.; Lepojev, O. (Inst. for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia). Exp. Parasitol., 20: 249-54(June 1967).

Alterations that occurred in juvenile forms of F. hepatica developing from irradiated metacercariae are reported. Metacercariae were obtained from snails (Lymnaea truncatula) exposed to miracida hatched from F. hepatica eggs of bovine origin. The metacercariae received an x-ray dose of 3000 R. Before being used for infection, they were stored at 4 to 6°C for 24 hr. Mice weighing 20 to 22 g were infected with 20 irradiated metacercariae and killed at weekly intervals over a period of six weeks. It was possible to compare parasites derived from irradiated metacercariae with those from normal metacercariae only for three weeks after infection. Thereafter, few or no specimens were obtained from mice given irradiated metacercariae, and most mice infected with normal metacercariae died before the experiment terminated. There were marked cellular and structural changes in the preadult forms derived from metacercariae irradiated at 3000 R. In irradiated metacercariae seven days postinfection, though similar in appearance to the normal stages, the sacculations of the ceca were thinner and shorter, and the epithelial cells lining them were less well developed, and about one-half the normal size. Embryonic cells of the genital rudiment were not so clearly delineated from the surrounding tissue as in the normal stages. The cecal sacculations at 14 days, although larger than those observed at seven days, were covered by acellular membranes with a cuticle-like structure. The cells of the genital rudiment had not undergone any further differentiation. In general, irradiation caused destruction and elimination of the epithelial cell-lining of the ceca, and suppression of the development of the genital organs. (BBB)

25986 LASER OPHTHALMOSCOPE. Ingram, H. Vernon. Bibl. Ophthalmol., 5: 358-67(1967).

After a description of the physical characteristics of the laser, and the use of a newly developed instrument, the effect of the laser beam on the eye fundus was described. The effect was apparently not one of thermal coagulation, but was rather due to disruption of molecules in a high electromagnetic field. The lesions produced were conical in shape, and could be easily correlated with the laser beam itself. High energies produced an explosion in the focal zone, with release of a gaseous bubble and rupture of the sclera. Pigmentation appeared early and was usually obvious in four days and well marked in seven. Adhesion of the choroid and retina developed with the pigmentation, and histological sections of rabbits' eyes confirmed the adequacy of the adhesion, and also showed how localized the lesions were. Although low doses of laser radiation did not produce retinal or vitreous hemorrhages, excessive doses could have a disastrous effect. In additional experiments, rabbits' eyes were exposed to high energies to simulate possible industrial accidents. Photographs illustrated the lesions produced. The scar produced in a rabbit's retina by the application of a 3-J burst 37 days previously was shown. With much higher energies, the retina and choroid were instantly disrupted and a hole appeared down to the sclera. The debris from this hole was blown into the vitreous and severe hemorrhage into the vitreous occurred, as shown by a photograph of a rabbit retina taken immediately after exposure to a 10-J ruby laser beam. Seconds later, the vitreous was full of blood and the fundus could not be seen. (BBB)

25987 PORPHYRIA AND PHOTOSENSITIVITY. Rimington, C.; Magnus, I. A.; Ryan, E. A.; Cripps, D. J. (London Univ.). Quart. J. Med., 36: 29-57(Jan. 1967).

Experimental data from photobiological and pharmacological

studies on three types of porphyria are presented: erythropoietic protoporphyria, porphyria cutanea tarda (PCT, or cutaneous hepatic porphyria), and variegate porphyria (South African genetic porphyria). To demonstrate abnormal skin photosensitivity, a high-output uv irradiation monochromator was used and 29 of 35 patients with porphyria were so investigated. Each narrow wavelength band was studied in turn using a number of exposures of increasing length; thus the approximate threshold dose could be estimated for any skin response at each spectral region. With the irradiation monochromator used, normal persons did not often show erythema reactions to wavelengths longer than about 330 mμ, if the dose was given in a practical time, e.g., 15 min, the longest exposure used on patients. With exposures of about 1½ hr it was occasionally possible to produce erythema with wavelengths longer than 330 mμ in normal persons. In an illustrative case of abnormal skin reactions to monochromatic irradiation a wealing response was seen in a case of PCT. Ultraviolet (300 mμ) irradiation gave a delayed erythema, i.e., a normal sunburn reaction, the threshold dose being about 1.7×10^5 μW sec/cm². The wavelengths 320 to 360 mμ gave no erythema, nor did 450, 700, and 800 mμ, in the visible spectrum. On the other hand, 380 and 425 mμ gave just perceptible urticaria reactions with large doses (6.8 and 10.2×10^6 μW sec/cm² respectively. The wavelengths 250 to 340 mμ gave delayed erythema reactions that were essentially within normal limits, though the threshold doses were high, e.g., 1.6×10^5 μW sec/cm² at 300 mμ. However, at 400 mμ a delayed edema response occurred; the threshold was about 3.3×10^6 μW sec/cm². The results indicated that the same wavelengths that were absorbed by the porphyrin molecule were those that caused lesions in the porphyric patient. This was in accordance with the Grotthus-Draper Law which states that only those wavelengths which were absorbed by a substance could excite it chemically. The concept that photosensitivity in porphyria was due to porphyrin in the skin was discussed, and it was concluded that light of wavelengths specifically absorbed by porphyrins could provoke reactions in the skin much in the same way as did natural sunlight. (BBB)

25988 STUDIES ON THE METABOLISM OF TETRAHYMENA PYRIFORMIS GL. III. EFFECTS OF γ IRRADIATION ON THE RESPIRATORY RATE. van de Vijver, G. (State Univ., Ghent). Enzymologia, 33: 331-44(Dec. 30, 1967).

Effects of ^{60}Co γ irradiation at a 3×10^5 to 6×10^5 R/hr dose rate on the oxygen uptake of whole cells and homogenate of the ciliate protozoan T. pyriformis, strain GL, were studied with the standard Warburg technique. Changes in the appearance of cells (motility, vacuolation, movement of cilia) were also observed. When Tetrahymena suspended in tap water were given increasing doses of radiation, oxygen consumption decreased with increasing dose, reaching 70% at 500,000 R. Cells irradiated in 0.017M phosphate buffer of pH 7.2 showed a markedly smaller decrease in respiration rate, even at 500,000 R (32% inhibition). The favorable influence of the phosphate buffer was pH dependent; ionizing radiation damage was considerably less at neutral or slightly alkaline pH than in acid range pH values. Respiration inhibition increased with postirradiation time, even when the protozoa were introduced into the phosphate buffer after exposure. On the other hand, if the ciliates were transferred immediately after irradiation to fresh nutritive medium 20 hr postirradiation, they showed enhancement of the oxygen uptake. Possible explanations for the relative radioresistance of invertebrates were discussed. Most invertebrates maintained their intracellular osmotic pressure with amino acids or small polypeptides, whereas in vertebrates the osmotic balance was maintained by inorganic ions. The amino acid content of invertebrates was relatively higher, and T. pyriformis had a high concentration of free amino acids. Part of the radioresistance of invertebrates might be explained by this biochemical fact. (BBB)

25989 LASER TREATMENT OF TATTOOS: A PRELIMINARY SURVEY OF THREE YEAR'S CLINICAL EXPERIENCE. Goldman, Leon; Rockwell, James; Meyer, Robert; Otten, Robert; Wilson, Robert G.; Kitzmiller, K. William (Children's Hospital Research Foundation, Cincinnati). J. Amer. Med. Ass., 201: 841-4(Sept. 11, 1967).

Effects of laser irradiation on pigmented skin of animals and humans are reported. Irradiation of tattooed skin with the intense radiation from the ruby (6943 Å) neodymium (10,600 Å), and argon (4880 to 5145 Å) lasers showed that the beam was more readily absorbed in highly pigmented tattoo dyes. As test models, bands of red, black, and green colors tattooed in the skin of rabbits and miniature pigs were used. The initial reaction was that of a charring and crusting in the area of the target (1.5 to 2 cm²) with the ruby and neodymium lasers. There was also spotted, superficial crusting with the argon laser. Oozing occurred for several weeks after the treatment until dry adherent crusts were formed. After these crusts peeled off, a flat reddened area was left. Small areas of tattoo masses sometimes were found in these areas. After this time, an initial opinion of the efficacy of the laser treatment was made. The progress was observed by repeated, standardized color photographic technique and biopsies, which showed nonspecific fibrosis and retention of a few scattered fragments of tattoo particles. No differences were observed between the pigment masses found in the treated areas and the untreated controls. The late reactions included secondary infection and hypertrophic scarring. Hypertrophic scarring in a series of 116 patients occurred in only three patients. In one patient, observed over a period of three yr, hypertrophic red scarring subsided after a year and became a smooth white scar. Hypertrophic scarring began to subside in the other two patients. This type of temporary hypertrophic scarring could occur, at times, in only portions of laser-treated areas even with similar energy densities given at the same time to adjacent areas of the tattoo. No keloidal reactions were seen. (BBB)

25990 RECOVERY PROCESS IN ORGANIZED TISSUE. Hornsey, Shirley (Medical Research Council, London). pp 587-603 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

The effects of radiation on the hematopoietic system for which the results of split-dose experiments can be compared with relevant cell survival curves is reviewed. The interpretation of the results of split-dose experiments on the acute intestinal syndrome and on skin damage is then considered. It is also shown how dose modifying agents, oxygen and LET, act on radioinduced tissue damage in a way that the effects reflecting cellular damage may be predicted. (B.S.L.)

25991 RESPONSE OF MAMMALIAN CELL POPULATIONS TO CONTINUOUS IRRADIATION. Lamerton, L. F. (Inst. of Cancer Research, Sutton, Eng.). pp 643-58 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Under continuous irradiation of mammalian tissues, two features become evident, higher doses can be accumulated by the tissue than at high dose-rates for brief exposures, and there is considerable difference in response between the various tissues of the body and between species. Factors affecting response include rate of cell proliferation within the tissue and the possibility of adaptation within the tissue. The former is affected by steady state dynamics that are influenced by both radiosensitivity and capacity to compensate for cell damage, and the latter is a reflection of a decreased sensitivity of the cells to subsequent irradiation following an initial exposure. In tissues having low cell proliferation rates, much larger doses can be accumulated without affecting their proliferative capacity. With high LET radiation, the differences between high and low dose-rate will be substantially reduced. (E.R.B.)

25992 RADIATION RESEARCH AND RADIATION PROTECTION. CLOSING LECTURE. Cockcroft, John (Cambridge Univ., Eng.). pp 905-14 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

Sir John Cockcroft relates the data and experiments that were significant contributions to radiobiological research from the late 1920's to 1966. He also discusses the importance of radiation dosimetry in relation to the radiation protection of man and the economic aspects of nuclear energy. (B.S.L.)

25993 DIURNAL RHYTHM OF EOSINOPHILS IN THE PERIPHERAL BLOOD OF MICE LONG AFTER γ IRRADIATION. Shapiro, F. B.; Panieva, I. M. (Moscow State Univ.). Nauch. Dokl. Vyssh. Shk., Biol. Nauki, No. 3, 107-8(1966). (In Russian).

Diurnal rhythm is a sign of adaptation to night in mice and depends on ACTH secretion, which is assumed to be altered by radiation due to changes in the adrenal cortex. It was studied in 1½ year old mice a year after irradiation with 500 R and in 3 to 4 month old mice irradiated in the uterus with 100 R on the 16th day of embryo development. Blood was taken at 9 AM, 2 PM and 8 PM. For eosinophil count, each animal served as its own control. Reactions to phenamine and ACTH administration were also tested. Irradiation was found to disturb the normal functional rhythm of the hypophysial system for long periods; in the older mice this was seen in less eosinophil increase during the day (11.6 against 22.5% in controls), less drop at night (30.8 against 50%), and less eosinophil reaction to phenamine administration. In the mice irradiated in the embryo stage and subjected to various conditions of lighting (day, night or 24-hour light or darkness), there was less increase in the day and no adaptation to various

lighting conditions. Tests for sensitivity of the adrenal cortex to ACTH revealed the absence of such reaction in the younger mice and thus a disturbance of adrenal cortex function in respect to stimulation by external and possible also internal ACTH. It was concluded that radiation caused long-lasting impairment of the adrenal cortex function; this did not exclude the possibility of additional damage to the hypophysial function. (ATD)

25994 LEUKOCYTIC AND GLYCEMIC REACTIONS OF THE ORGANISM FOLLOWING SINGLE AND FRACTIONAL LOCAL IRRADIATION. Remizova, I, V. Radiobiologiya, 7: 417-21 (1967). (In Russian).

In experiments on rabbits, a single irradiation of the head with 900 R of x rays, that did not produce a statistically valid leukopenia, led to distorted leukocytic and lowered glycemic reactions to epinephrine in the early period after exposure. A single irradiation of the abdomen with the same dose produced moderate leukopenia and led to the same adrenaline reactions as irradiation of the head, but they were less pronounced and more extended in time. Fractional irradiation of the head or abdomen (150 R × 6) led to less pronounced leukocytic reactions than a single irradiation, while the glycemic reactions were much more pronounced in the early period after irradiation and were of a diabetic type. The results indicated that functional stressing with epinephrine made it possible to detect hidden changes in the blood system that arise from radiation.

25995 RECOVERY FROM RADIATION INJURY IN THE HAMSTER AS EVALUATED BY THE SPLIT-DOSE TECHNIQUE. Holloway, R. J.; Leong, G. F.; Ainsworth, E. J.; Albright, M. L.; Baum, S. J. (Naval Radiological Defense Lab., San Francisco). Radiat. Res., 33: 37-49(1968).

The split-dose technique was used to determine the pattern of recovery from radiation injury in the Syrian hamster. Exposure of the animals to 1-mVp x rays resulted in a $LD_{50(30)}$ of 941 R. Recovery during the first 20 days was found to be nonexponential; in fact, a marked transient increase in radiosensitivity was observed during the second week after a conditioning exposure to $\frac{2}{3}$ $LD_{50(30)}$. The patterns of changes in erythrocytes, granulocytes, thrombocytes, and mononuclear cells are discussed in light of the change in the time-dependent radiosensitivity. Survival time was found to be inversely related to exposure, the higher the exposure, the shorter the survival time, in all irradiated groups except the group challenged at three days. The survival time at the $LD_{50(30)}$ varied with the day of challenge. (auth)

25996 REDUCTION IN DNA AND RNA CONTENT DURING THE DEVELOPMENT OF HAPLOID RANA PIPIENS EMBRYOS. Greenslade, F. C. (Tulane Univ., New Orleans). Experientia, 23: 1075-6(Dec. 15, 1967).

A micro-biochemical method was used for comparing quantities of DNA and RNA in haploid and diploid developing embryos of the frog, Rana pipiens. Haploid embryos resulting from uv-irradiation of sperm became deficient in their total DNA content by the tail bud stage, and in their RNA content by the hatching stage. The period at which haploid and diploid nucleic acid content became dissimilar coincided with one of increasing abnormality for haploid embryos. The abnormal development of haploid embryos was accompanied by a reduction in the net synthesis of both DNA and RNA. Because differences between haploids and diploids in DNA and RNA content are not detectable for several hours after gastrulation, a direct causal relationship between nucleic acid synthesis and the syndrome may be precluded. (tr-auth)

25997 PERICARDIAL EFFUSION FOLLOWING RADIATION TO THE CHEST: REPORT OF A CASE. Teng, Cheng Yee; Nemickas, Rimgaudas; Tobin, John R. Jr.; Szanto, Paul B.; Gunnar, Rolf M. (Cook County Hospital, Chicago). Dis. Chest, 52: 549-52(Oct. 1967).

Among the various causes of chronic massive pericardial effusion, radiation injury has been cited in only one previous report. The patient described here developed such an effusion two yr after massive irradiation of the left anterior chest for carcinoma of the breast. Although the histologic appearance of the pericardium of this patient did not have the so-called elephant-skin quality as described in the earlier case, the clinical courses of the 2 cases were similar and both considered to be a result of radiation injury. The 43-yr-old woman received 200-kV x-ray therapy in 49 treatments to the left anterior chest, left axilla, and left supraclavicular areas for a total of 10,000 R. Chest x-rays, taken in the eighth week of therapy, showed minimal left ventricular enlargement, and six months later showed distinct enlargement of the cardiac silhouette. An ulcer appeared in the irradiated skin, and decreased in size with topical therapy but did not heal. She was hospitalized on two occasions for pain at the site of the ulceration, and biopsies revealed a histologic picture of radiation necrosis. The patient developed pericardial effusion and died $1\frac{1}{2}$ yr after radiotherapy was given. Histologic examination of ventricles and atria revealed fibrinous pericarditis. Beneath this relatively thin exudate, there was a thick layer of dense connective tissue with a moderate degree of focal cellular infiltration comprised chiefly of lymphocytes and occasional macrophages. The sub-epicardial fat tissue was replaced by dense fibrous connective tissue. (BBB) (TSS)

25998 INVESTIGATIONS ON THE IMPORTANCE, BIOSYNTHESIS, AND METABOLISM OF THE GLUCOCORTICOIDS IN ACUTE RADIATION SYNDROME. Winkler, C.; Schorn, H. (Univ., Bonn). Strahlentherapie, Sonderbaende, 65: 294-302 (1967). (In German).

From 7th International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gastein, Austria. See CONF-660121.

In acute irradiation syndrome adrenal function and corticosteroid metabolism are affected. Since little is known about these radiation-induced changes in man, comparative studies were carried out in animals. Rats and guinea pigs were irradiated with 200 kV x rays to a total of 1000 rads and dogs were irradiated with ^{60}Co γ rays to a total of 2000 rads. Biosynthesis of adrenal hormone was evaluated by incubating the adrenals of the irradiated animals with ^{14}C- and ^{3}H-labeled cortisol precursors. Corticosteroid metabolism was assayed after application of ^{14}C-labeled cortisol or corticosteron using paperchromatography, thin layer chromatography, and liquid scintillation counting methods. There were some differences between the different animals, but the most important finding was a considerable increase of the rate of cortisol production together with an atypical progesteron utilization. Abnormalities in the conjugation processes and changes in the relative distribution of metabolites were observed as a result of radiation effects on cortisol metabolism. These results agree well with those obtained in similar experiments incubating liver slices. The pathophysiological meaning of the results is discussed. (auth)

Radiation Effects on Plants

Refer also to abstracts 25713, 25721, 25738–25740, 25757, 25800, 25801, 25803, 25805–25810, 25812, 25813, 25818, 25820 25823, 25865, 25866, 25870–25872, 25891, 25910, and 25992.

25999 STUDIES ON RADIOSENSITIVITY OF FOREST TREES. 5. DIFFERENCE IN RADIOSENSITIVITY OF SELF- AND CROSS-POLLINATED SEEDS, AND OF SEEDS WITH A MARKER GENE IN SUGI, CRYPTOMERIA JAPONICA D. DON. Oba, Kihachiro (Inst. of Radiation Breeding, Japan); Murai, Masafumi. Nippon Ringaku Kaishi, 49: No. 2, 45-52(Feb. 1967). (In Japanese).

Radiosensitivity of self- and cross-pollinated seeds, and of seeds with a marker gene in Sugi, Cryptomeria japonica D. Don was studied. Five seed groups, namely, selfed seed lots of naturally (TG-5) or gibberellin induced flowers (BG-5) of a tree, G-5, and naturally set flowers (C-5) of another tree, C-5, and TG-5 × C-5, and open pollinated seeds of TG-5, were irradiated with acute gamma rays (3,000 R/day) of 6,000, 12,000 and 15,000 R in the gamma field of the Institute of Radiation Breeding. The selfed seeds from gibberellin induced flowers had less viability in the control and after gamma ray treatment they showed further retardation in germinability. On the other hand, open pollinated seeds from TG-5 showed the highest resistance to the radiation. Hybrid seeds between two trees showed intermediate germination percentage between those of open pollinated seeds and selfed seeds of artificially induced flowers, and a slightly higher value than those of selfed seeds of both their parents, indicating a heterotic effect of the hybrid seeds on the radiosensitivity. With those germination percentage resulted from the irradiated seeds, genetical and physiological share on the radiosensitivity was estimated, and the genetical portion was dominant over the physiological in 12,000 and 15,000 R exposure. The tree, G-5, proved to have a recessive gene producing seedlings with light green cotyledon in 3:1 ratio after selfing in both naturally or gibberellin induced flowers. The selfed seeds (BG-5) after gibberellin treatment were irradiated with gamma rays to examine their segregation ratio, and biased ratios favoring lower percentage of the variants were noted. It was thought that the genetical composition of a seed population may be slightly changed in the X_1 population by selective damage of the radiation on seeds with some special genotypes. Abnormality in cell division expressed by percentage of cells with chromosomal bridge increased linearly with the intensity of gamma exposure. (NSA of Japan)

26000 NATURE OF THE PLATEAU OF PHOTOREACTIVATION OF YEAST CELLS. Kabakov, E. N.; Korogodin, V. I.

(Inst. of Medical Radiology, Obninsk, USSR). pp 109-17 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Saccharomyces vini strain Megri 139-B received a dose of uv radiation that reduced survival to 1 to 3%; they were then photoreactivated at maximum and minimum luminosities of 17,000 and 6,000 lux/cm^2, respectively. It was found that all cell injuries induced by uv radiation could be photoreactivated and that a certain probability of loss of that ability was possible; the plateau of the photoreactivation curve was caused by that loss. An equation describing the process of photoreactivation is presented. (JPRS)

26001 DATA ON THE OXYGEN CONSUMPTION OF YEAST CELLS DURING POSTIRRADIATION RECOVERY. Mosin, A. F. (Inst. of Medical Radiology, Obninsk, USSR). pp 74-8 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Diploid yeasts, Saccharomyces vini strain Megri 139-B, received 67, 134, and 268 kR of irradiation and were incubated for one day in a nonnutrient medium; oxygen consumption was recorded during this time. Survival was determined by counting microcolonies and recovery was expressed as percentage of viable cells. The respiration of irradiated cells was more intensive than that of the nonirradiated cells throughout incubation and increased with increasing dose. Although the conditions of pre- and postirradiation incubation varied greatly, the amount of additional oxygen consumed by the irradiated as compared with the nonirradiated per unit of recovery was constant. (JPRS)

26002 THE USE OF SODIUM ARSENATE TO DETERMINE THE TIMES FOR DEVELOPMENT OF POTENTIAL INJURIES OF SACCHAROMYCES VINI. Kabakova, N. M.; Kabakov, E. N. (Inst. of Medical Radiology, Obninsk, USSR). pp 79-83 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Sterile tap-water suspensions of Saccharomyces vini strain Megri 139-B were x-irradiated at 16.6, 21.6 and 31.6 kR doses. Cells from the irradiated suspensions (1 to 5×10^6 cells/ml) were sown on cellophane film lying in dishes covered with wort-agar. Survival was determined by the number of microcolonies; the mean number of cells per colony was determined every two hours during a 14 hour period. The films were then placed on filter paper that was impregnated with 2.5×10^{-2} M sodium arsenate solution that suppressed cell division by reversibly blocking ATP synthesis. After 23 hours at 30°C the films were placed on filter paper impregnated with tap-water to remove the sodium arsenate and then on fresh wort-agar for incubation. Since the multiplication of the cells could be halted at any moment, the degree of development of radiation injuries could be determined by the level of maximum recovery. Injury development was independent of the dose and occurred during 5 to 10 hours of the incubation on the nutrient medium, evidently at the first postirradiational division even if the inactivation occurred after several cycles of multiplication. (JPRS)

26003 STUDIES ON MUTATIONS INDUCED BY RADIATIONS. I. JAPANESE MORNING GLORY (PHARBITIS NIL CHOIS (1). Shimadzu, Nariyasu; Kashimura, Katsuji (Ibaraki Univ., Japan). Ibaraki Daigaku Nogakubu Gakujitsu Hokoku, No. 14, 1-7(Oct. 1966). (In Japanese).

With a view to investigate the effects of various radiation treatments on the variations of plants, radiation treatments by γ rays, β rays and thermal neutrons were conducted employing five varieties of Japanese morning glory (Pharbitis nil Chois). Seeds were γ-irradiated (^{60}Co) at doses of 5 to 40 kR and 30 to 70 kR in 1960 and 1961 respectively. The result of the survey on plant growth indicated that the plants from 5 to 40 kR-irradiated seeds showed more vigorous growth than those from non-treated seed. Growth was impeded to a considerable extent in seed irradiated at a dose of 40 to 50 kR. Even the seeds irradiated at a dose of more than 60 kR and which had once sprouted, withered at the stage of seedling. Among the offsprings of the plants subjected to γ rays, there appeared mutants in terms of the shape of grass, tinge of leaves, flowers and so on. Two kinds of mutant characteristics, i.e., "greenish white seedling, lethal" and "dwarf, earliest flowering" which appeared in the M_2 generation of 20 kR radiation treatment, were involved with a recessive gene. This judgement was based on the condition of segregation in M_2-M_7 generations. These recessive genes were respectively named greenish white seedling (wg) and earliest flowering and dwarf (ed). Among the offsprings of the seeds treated with β rays (^{32}P aqueous solution, 0.1 and 0.5 mc/cc) and thermal neutrons (5×10^3 nth/cm^2/sec), no cases of mutants individuals were observed. (TSS) (NSA of Japan)

26004 ANAEROBIC FERMENTATION AND POSTIRRADIATION RECOVERY OF YEAST. Mosin, A. F. (Inst. of Medical Radiobiology, Obninsk, USSR). Radiobiologiya, 7: 565-71(1967). (In Russian).

Sterile tap-water or phosphate buffer (pH = 7.0) suspensions of Saccharomyces vini strain Mergi 139-V were irradiated in air at room temperature at a dose rate of 60 R/sec for a dose of 110 to 140 kR. Various substances were then added to the suspensions and they were incubated for 8 to 24 hours at 30°. It was found that suspensions incubated under anaerobic conditions could recover from a considerable part of radiation damage if iodoacetate was added to the suspension. The recovery was accomplished by metabolic transformation of endogenous hydrocarbons whose fermentation was considerably changed by the action of iodoacetate. In the presence of glucose at the minimum concentration assuring a maximum recovery level of the cells, a tenfold suppression of the glycolytic activity by iodoacetate did not influence the rate or volume of subsequent recovery. This indicated that intensive fermentation is not a necessary condition for recovery. (JPRS)

26005 POSTIRRADIATION RECOVERY OF YEAST. Korogodin, V. J.; Meissel, M. N.; Remesova, T. S. (Inst. of Medical Radiology, Obninsk, USSR. Inst. of Microbiology, Moscow). pp 538-57 of Radiation Research. Silini, G. (ed.). Amsterdam, North-Holland Publishing Co., 1967.

From 3rd International Congress on Radiation Research, Cortina, Italy, June–July 1966. See CONF-660614.

An analysis of the inactivation phenomenon in yeast revealed quantitative regularities of recovery. This should be expressed as a decrease in the effective dose of radiation. Rate of recovery may be different for yeast of different strains. However, in closely related groups of strains, recovery rate does not depend upon ploidy. Recovery of viability of irradiated yeast is inherent only in the strains with two or more chromosome sets. Haploid yeast is not able to recover lethal damage. One of the first features of irradiation damage of yeast cells is a delay as well as anomaly of nuclear division. Recovery results in a normalization of this process. The first morphological indications of recovery in yeast appear in the mitochondria, then in the endoplasmic reticulum, and finally the normal function of the nucleus is restored. Cytological and biochemical investigations show that potential irradiation damages become apparent during the first nuclear postirradiation division. Postirradiation dark recovery of the yeast is an enzymatic process requiring endogenous respiration, a supply of energy, a definite ATP resynthesis level, intact cytochrome systems and capability of the cell for glycolysis. Post-irradiation yeast recovery requires an intracellular amino acid pool, pyridoxal enzyme activity, sufficient pyridine coenzyme level, and increased high molecular stability of nucleoprotein complexes. Along with similarities, there are some differences between the mechanisms of yeast dark recovery after uv and ionizing radiation damage and damages induced by different chemical radiomimetic agents. Since microbial cells incubated in poor medium restore the damage induced by different agents it can be assumed that cell recovery after various spontaneous damages to genetic and nongenetic structures proceeds under natural conditions as well. Such recovery mechanisms that have originated and become established in the course of evolution are certainly of great biological significance. (auth)

26006 CHANGE IN SOIL FROM EFFECTS OF GAMMA IRRADIATION. Boyer, Jean (ORSTOM, Antony, France); Combeau, Andre; Grauby, Andre; Thomas, Anne-Marie. Bull. Inform. Sci. Tech. (Paris), No. 106, 1-17(July-Aug. 1966). (In French).

Changes were observed in agricultural, biological, chemical, and physical properties of soils of different origins following irradiation in the swimming-pool reactor Fontenay-aux-Roses (Triton) (gamma flux of 4 megarads). Tables are presented to show the effects of gamma radiation on the microorganisms, Actinomycetes, Azotobacter, ferruginous bacteria, and other fungi. The organisms were almost completely destroyed by radiation. Experiments were conducted with clover and rye grass using irradiated and unirradiated soil with and without the addition of fertilizers. Experiments without fertilizer showed that both clover and rye grass grew faster on irradiated soil for the first two months; however, after a longer period of time, plants growing on control soil were superior to those on irradiated soil. Clover growing on irradiated soil did not develop root nodules, while nodules were present on roots growing in control soil. Rye grass was grown in soils to which the fertilizers, ammonium nitrate, ammonium phosphate, calcium nitrate, and calcium phosphate were added. The growth of rye grass on unirradiated soil was improved by all fertilizers. Growth on irradiated soil was greatly improved by ammonium nitrate and slightly improved by

other fertilizers. Clover was grown in soils to which ammonium phosphate were added. Growth in unirradiated soil containing ammonium phosphate was better than that in irradiated soil. Growth in both irradiated and unirradiated soil with calcium phosphate was inferior to that in soil without fertilizer. A reduction in structural stability was found in the irradiated soils; the Atterberg limits were displaced and the pH seemed to decrease. The composition of extractable organic substances was greatly modified by a pronounced rise in value of the fulvic acid fraction. (H.L.W.)

Radiation Effects on Microorganisms

Refer also to abstracts 25713, 25720, 25732, 25740, 25780, 25782, 25783, 25792, 25793, 25797, 25814, 25818, 25822, 25873–25875, 25992, 26006, and 26752.

26007 (TID-24230) DIRECT AND INDIRECT EFFECTS OF GAMMA RADIATION ON YEAST CELLS. Diaz-Santiago, Noemi (Michigan State Univ., East Lansing). 1967. Contract AT(11-1)-1592. 58p. Dep. CFSTI.

Thesis.

The effects of γ radiation on the survival of several species of yeasts involved in the spoilage of fruits and dairy products were investigated. The direct effects of doses of 100 to 300 Krad γ radiation on the survival of Saccharomyces cerevisiae, Candida krusei, and Rhodotorula glutinis in water, synthetic medium, and canned apple juice were measured. Indirect effects of γ radiation were studied by determining survival on synthetic media or apple juice irradiated with doses of 0 to 4 Mrad γ radiation. The lowest percent of outgrowth was obtained when the cells were grown on synthetic media containing sucrose irradiated at 4 Mrad. A significant suppression of growth was observed when the yeasts were grown on either canned or filter-sterilized apple juice pre-irradiated to 4 Mrad. (C.H.)

26008 THE NUCLEIC ACID CONTENT OF RADIORESISTANT VARIANTS OF E. COLI CULTURED DURING CONTINUOUS γ IRRADIATION. Zhestyanikov, V. D. (Inst. of Cytology, Leningrad). pp 51–6 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

The nucleic acid content was determined in cells of E. coli B, B/r, K12 and their γR-variants (12 strains), and also in two groups that were cultivated with and without γ irradiation for three to four and 11 to 13 generations. Most of the γ-resistant strains contained more DNA and RNA than the original cultures (2.25 to 2.5 and 1.0 to 1.5 times as much for those having undergone three to four and 11 to 13 generations respectively). (JPRS)

26009 THE TIMES OF REPAIR AND DEVELOPMENT OF RADIATION INJURY OF E. COLI B. Zhestyanikov, V. D. (Inst. of Cytology, Moscow). pp 40-6 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Escherichia coli B were x-irradiated in air for one minute at a dose rate of 6 and 15 krads/minute and then incubated for 24 hours. In one series of tests the bacteria were kept at 45°C for one, two and three hours and then at 37°C for the remaining time; in another series they were kept at 37°C first and then at 45°C. It was found that the development of radiation injury was confined to the time of first cell division and that postirradiation recovery was accomplished during the period of first cell division. (JPRS)

26010 POSTIRRADIATION RECOVERY IN BACTERIA. Val'dshtein, E. A.; Zhestyanikov, V. D. (Inst. of Cytology, Leningrad). pp 5-19 of Zashchita i Vosstanovlenie pri Luchevykh Povrezhdeniyakh. Graevskii, E. Ya.; Ivanov, V. I.; Korogodin, V. I. (eds.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

A review of the literature on postirradiation recovery in bacteria is presented. (JPRS)

26011 THE EFFECT OF VARIOUS COL I FACTORS ON THE INDUCTION OF PHAGE P22 BY ULTRAVIOLET RADIATION. Walsh, Joan; Meynell, G. G. (Lister Inst. of Preventive Medicine, London). J. Gen. Virol., 1: 587-8(Oct. 1967).

The burst size of phage P22 in Salmonella typhimurium strain LT2 was 200 to 1000, whether a clear-plaque mutant or a low multiplicity of wild-type (c^+) phage was used. However, when vegetative phage growth was induced in strain LT2 lysogenized by c^+ phage by exposing it to uv light from a low-pressure Hg lamp, the burst size was far smaller and usually less than 40. This occurred even when the prophage was a nonexcluding mutant and the bacteria were superinfected with virulent (c_2) phage just before irradiation, despite the appearance of both c^+ and c_2 phage in the burst. This suggested that the uv dose producing maximal induction damaged the bacteria to a degree that severely limited their capacity to support phage growth. Since strain LT2 not lysogenized by phage P22 became markedly more resistant to killing by uv radiation when it carried certain colicin I factors, their effect on lysogenic strains was tested. Resistance to both killing and induction were found to be increased without affecting the burst size. Comparison of col– and col+ strains showed that all the col factors increased resistance to killing and induction. For each strain, the optimal inducing dose was directly related to its resistance to killing. The burst size was smaller, the larger the uv dose. The behavior of these strains varied markedly, but, in general, a col I+ culture exposed to a given uv dose behaved like a col– culture exposed to a smaller dose. (BBB)

26012 FACTORS AFFECTING THE RECOVERY OF GAMMA-IRRADIATED ESCHERICHIA COLI. Cook, A. M.; Widdowson, Jean P. (School of Pharmacy, London). J. Appl. Bacteriol., 30: 206-18(Apr. 1967).

Two methods of viable counting were compared for unirradiated and γ-irradiated E. coli NCTC 5933. The spread plate method was shown to be more reproducible than a serial dilution method in a liquid medium, but the survivor-dose curves of γ-irradiated bacteria obtained by the two methods were identical. The spread plate method was used to compare the survival of γ-irradiated E. coli on peptone agar and on a synthetic glucose-salts agar over a range of survivor levels of nine log cycles. The log % survivor-dose curve was linear for the synthetic medium but had a double exponential shape for the peptone agar. Recovery was much higher on peptone than on a synthetic medium. Using a tube dilution method in a liquid glucose-salts medium, 19 L-amino acids were tested for their effect on recovery. The slight increases in number of survivors attributable to some amino acids were associated with a change in the first part (100–1% survivors) of the curve rather than an alteration in final slope. The phosphate concentration of the solid synthetic medium markedly affected its ability to recover γ-irradiated cells. (BBB)

26013 EXCISION OF LAMBDA PROPHAGE: EFFECTS ON HOST SURVIVAL. Eisen, H. A.; Siminovitch, L.; Mohide, P. T. (Univ. of Toronto. Ontario Cancer Inst., Can.). Virology, 34: 97-103(Jan. 1968).

Induction with ultraviolet light of K12 lysogens carrying defective prophages leads to death of the host cell. In order to determine whether the killing accompanying induction was due to diffusible phage products, or was a result of prophage excision itself, the survival of lysogens carrying DNA defective prophages on an extra chromosomal site (the F-gal episome), were examined. Induction of prophages, carrying mutations in the x region, or the N, O or P cistrons, from this location, did not result in host death, but, with the exception of mutants in the x region of the λ chromosome, it did result in loss of the episome. On the basis of these results, it is proposed that the lethal event in induction of the DNA-defective mutants is due to prophage excision, which leads to interruption of the host chromosome, and cell death. (auth)

26014 THE LURIA–LATARJET EFFECT STUDIED BY T4-LYSOZYME PRODUCTION. Fisher, Daniel B.; Pardee, Arthur B. (Princeton Univ., N. J.). Virology, 34: 91-6(Jan. 1968).

The replication of bacteriophage T4 in Escherichia coli is sensitive to ultraviolet light (UV). The classical plaque assay shows a considerable increase in UV resistance starting at about 5 min after the bacteria are infected. Production of phage lysozyme starts about 10 min after infection and is sensitive to irradiation. Its UV resistance increases at about 4 min. The appearance of resistance, measured by both the plaque and lysozyme production, is inhibited by p-fluorophenylalanine. Resistance appears at the normal time in bacteria infected by a mutant phage amN116 whose major DNA synthesis is delayed beyond 20 min. These results suggest that the same event is responsible for resistance of both plaque formation and lysozyme production. The principal advantage of the lysozyme assay is that resistance can be detected more directly than with the plaque assay. Bacteria irradiated 7 min after infection were resistant when tested at 11 min. Resistance mechanisms that depend on gradual recovery after plating are ruled out by these results. So are mechanisms that require extensive DNA synthesis. The results are consistent with an event that takes place 5 min after infection and requires protein synthesis and at most a small quantity of DNA synthesis. They are in accord with a highly UV-sensitive switch from early to late functions being the principal initial target. (auth)

26015 EXCISION OF THE LAMBDA PROPHAGE: EFFECTS ON LINKAGE RELATIONSHIPS OF ESCHERICHIA COLI CHRO-

MOSOME. Eisen, H. A.; Tallan, I.; Siminovitch, L. (Univ. of Toronto. Ontario Cancer Inst., Can.). Virology, 34: 104-11(Jan. 1968).

As a result of earlier work with K12 lysogens carrying defective prophages, it was proposed that the lethal event in induction was due to interruption of the host chromosome and that the different levels of survival after induction with ultraviolet light of DNA defective mutants, in the x region, and the N, O, and P cistrons, was due to different extents of repair. To test this model, the effects of zygotic induction on the linkage between two bacterial markers, gal and bio, on either side of the λ prophage, was examined. This linkage was destroyed after zygotic induction of mutants in the N cistron. Zygotic induction of mutants in cistron O resulted in a 5-fold depression of the linkage, while induction of mutants in cistron P and in the x region resulted in complete restoration of the linkage. The results are discussed in relation to the model of excision, and possible different extents of repair. (auth)

Radiosterilization and Radiopreservation

Refer also to abstract 26007.

26016 (NYO-3499-3) STABILITY OF FOOD LIPIDS TO IONIZING RADIATION. Final Report. Nawar, Wassef W. (Massachusetts Univ., Amherst. Dept. of Food Science and Technology). Feb. 1968. Contract AT(30-1)-3499. 21p. Dep. CFSTI.

LIPIDS—radiolysis of meat, yield of hydrocarbons from γ
MEATS—radiation processing of beef, pork, and fish, effects of, on organoleptic properties, γ (C.H.)

26017 (TID-23835) APPLICATION OF RADIATION-PASTEURIZATION PROCESSES TO PACIFIC CRAB AND FLOUNDER. Final Summary Report, November 1965-October 1966. Miyauchi, David; Spinelli, John; Pelroy, Gretchen (Bureau of Commercial Fisheries, Settle, Wash. Technological Lab.). Nov. 1966. Contract AT(49-11)-2058. 115p. Dep. CFSTI.

MEATS—seafood, radiation processing of, feasibility of γ
SCHIZOMYCOTA—detection in radiation processed seafood, development of tests for; growth in radiation processed seafood, effects of oxygen abundance and pH on
EUMYCOTA—yeasts, growth in radiation processed seafood, effects of oxygen abundance and pH on
SODIUM PHOSPHATES—treatment of seafood before radiation processing, effects of, on organoleptic properties
NITROGEN—effects on effectiveness of radiation processing of seafoods (B.S.L.)

26018 RADIATION OF FOOD. Roe, Robert S. (Food and Drug Administration, Washington, D. C.). FDA (Food Drug Admin.) Pap., 1: 24-9(May 1967).

The surveillance program of the Food and Drug Administration with respect to the wholesomeness of radiopreserved foods and additives used in them was outlined. Appraisal of the safety of various proposed applications of radiation to food products required data needed to show: whether exposure to ionizing radiation caused induced radioactivity in the treated food, whether ionizing radiation treatment produced toxic substances in the food exposed to the treatment, whether proposed treatments adversely affected the nutritive values of exposed food, whether the proposed treatments were effective for the intended purposes, and what doses were necessary to accomplish the purposes. The Food and Drug Administration suggested two-yr (chronic) feeding experiments with rats and dogs, essentially the same protocol as for other food additives. These tests needed to be evaluated for general toxicity, pathogenicity, carcinogenicity, and effects on reproduction. The question of how much safety data was needed on individual foods when data were available on other foods of the same general class was discussed. It was suggested that if long-term chronic feeding studies were obtained on one irradiated food, such data could not be used in evaluating safety with respect to another irradiated food. Reports on the apparent adverse effect of irradiation on sugar solutions and consideration of the variations in composition of different fruits as regards carbohydrates, acids, and other constituents questioned the rationale of extrapolation of safety data. Until more information was available that would give sound basis for extrapolation, long-term tests were necessary to enable sound safety appraisals of radiation treatment of specific products. Reports of mutagenic changes in bacteria from exposure to ionizing radiation, and of temporary inhibition of bacterial activity with likelihood of later resumption of viability, suggested the need for possible additional or revised protocols for safety evaluations in appraisal of microbiological aspects. (BBB)

26019 NATURE OF MICROBIOLOGICAL DECAY OF FRESH FRUITS AND VEGETABLES TREATED WITH IONIZING RADIATION. Koval'skaya, L. P.; Silaeva, S. V. Konserv. Ovoshchesush. Prom., No. 5, 33-8(1966). (In Russian).

Fresh strawberries, raspberries, apricots, peaches and plums irradiated with 2×10^3 to 3×10^3 Rad doses were studied in stores and storage centers to determine the factors responsible for microbiological decay. Microorganism growth of irradiated and nonirradiated fruits was evaluated on the basis of yeast and mold counts taken for periods up to 20 days. Findings show that the decay rate of irradiated fruits is determined first of all by the restoration of spontaneous microflora. However, it is incorrect to maintain that irradiation inhibits all the microflora to the same degree or that the nature of the decay which appears somewhat later is always the same as in nonirradiated fruit. The qualitative composition of the microflora is important, and even more important is the radioresistance of each of the species. The role of secondary infection is insignificant when fruit is stored under normal sanitary conditions. But, with a high level of air contamination, decay may occur earlier. The latter generally takes place with a prolonged storage period during which mold fungi have sufficient time to penetrate and develop in fruit tissue. (ATD)

26020 EFFECT OF OXYGEN TENSION ON THE SPOILAGE MICROFLORA OF IRRADIATED AND NONIRRADIATED HADDOCK (MELANOGRAMMUS AEGLEFINUS) FILLETS. Licciardello, J. J. (Massachusetts Inst. of Tech., Cambridge); Ronsivalli, L. J.; Slavin, J. W. J. Appl. Bacteriol., 30: 239-45(Apr. 1967).

The effect upon the microbial flora of haddock of treatment with a pasteurizing dose of ionizing radiation, followed by refrigerated storage under either high or low oxygen tension, was studied. The spoilage microflora of irradiated and nonirradiated air-packed or vacuum-packed haddock fillets was identified after storage of the fillets at 35°F. With the nonirradiated fillets, both air-packed and vacuum-packed, the spoilage flora was predominantly pseudomonads. With the irradiated fillets, the spoilage flora of the air-packed samples was chiefly achromobacter; that of the vacuum-packed samples was chiefly lactobacilli (or possibly Microbacterium thermosphactum). Irradiation with 150,000 rad caused a shift in the frequency distribution pattern of the microflora for both air- and vacuum-packed fillets, the survivors, being mostly achromobacters, followed by micrococci, and a few yeasts. The pseudomonads were either completely eliminated or reduced to a very low level. Of the psychrophilic spoilage bacteria, the achromobacters were among the most resistant to irradiation and the pseudomonads the least resistant. The micrococci were probably more resistant than are the achromobacters, and more achromobacters survived irradiation than cocci because more were present initially. A higher irradiation dose would probably have destroyed more of the achromobacters and allowed more of the micrococci to grow. (BBB)

26021 A COMPARISON OF AUTOCLAVED AND GAMMA-IRRADIATED SOILS AS MEDIA FOR MICROBIAL COLONIZATION EXPERIMENTS. Salonius, P. O.; Robinson, J. B.; Chase, F. E. (Univ. of Guelph, Can.). Plant Soil, 27: 239-48(Oct. 1967).

Some changes induced in soil by sterilizing doses of γ irradiation were studied, especially those changes that might influence subsequent microbial growth. These studies were limited to water-soluble material in the soil because it probably reflected the available microbial nutrient supply in soil and because of the difficulties involved in analysis of soil as a whole. Properties of Lincoln Clay after a sterilizing dose of γ radiation (3.0 Mrad) were compared to those after autoclaving the soil (121°C) for 1 hr. Effects of both treatments were much more drastic when moist rather than when air-dry soil was treated but, in general, irradiation had less effect on soluble organic matter and on total water-extractable electrolytes than did autoclaving. Irradiation caused a greater release of NH_4-nitrogen from soil treated moist than did autoclaving but the reverse was true in dry soil. Alcohol-soluble ninhydrin-positive material was increased by both sterilization procedures, with irradiation having the greater effect. The aggregate stability of Lincoln Clay was decreased by irradiation and increased by autoclaving. Pure cultures of both Arthrobacter sp. and Pseudomonas sp. grew better, on the basis of cell yields, in irradiated than in autoclaved soil. Respiration of mixed soil organisms in an artificial soil amended with an extract of irradiated soil was almost identical with that in an extract of air-dried soil, but autoclaved soil extract was only metabolized after a prolonged lag period. (BBB)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

26022 (IS–2029) PURITY-GRADE METALS AVAILABLE FROM AMERICAN PRODUCERS. Wilhelm, H. A. (comp.) (Ames Lab., Iowa). Nov. 1967. Contract W-7405-eng-82. 76p. Dep. CFSTI.

Tables of almost 90 metals (arranged alphabetically) are presented which give: purity, impurities, preparation method, forms and sizes available, prices, and producer. The purity varies from ultra-pure to commercial grades. A list of producers and addresses is included. (D.L.C.)

26023 WHERE RHENIUM IS GROWING. Spelman, Jon W. (Chase Brass and Copper Co. Inc., Solon, Ohio). Metal Progr., 93: 103–4; 108; 110; 112; 114(Feb. 1968).

The advantageous mechanical and physical properties of Re are discussed. The varied uses of Re in thermoelements, electronic tubes, contacts, and catalysts are described. Progress in Re plating is discussed. (D.L.C.)

26024 INTERMETALLIC COMPOUNDS. Westbrook, J. H. (ed.). Wiley Series on the Science and Technology of Materials. New York, John Wiley and Sons, Inc., 1967. 678p. $29.75.

A brief historical sketch of the development of the subject is given. The bonding and crystal structure of intermetallic compounds are presented. Each of these two parts is introduced by a survey chapter reviewing the main features of the topic. In the case of bonding, this survey is followed by a series of chapters presenting viewpoints of bonding as revealed by various experimental or theoretical techniques. The chapters on crystal structure are organized by structural families. The next three parts of the book consider, in turn, topics relating to microstructure, substructure, formation, stability, constitution, kinetics, and transformations. The final part of the book consists of seven chapters treating specific classes of properties and the resultant applications. Separate abstracts were prepared for 2 of the 29 chapters; the other chapters were not in scope of NSA. (M.H.R.)

For abstracts of individual chapters see: 26346 and 26496.

26025 METHOD OF MANUFACTURING ALUMINUM-CLAD NUCLEAR FUEL ELEMENTS BY HOT-SWAGING IN AIR. Precht, Walter; Geckle, Raymond J.; Frank, Louis (Martin-Marietta Corp.). U. S. Patent 3,349,466. Oct. 31, 1967. Filed May 2, 1960.

A metallurgically bonded Al-clad tubular fuel element assembly comprises a hollow tubular core encased by inner and outer concentric Al tubes. The core contains from 25 to 50% of Al particles mixed with particles of fissionable materials as UO_2, U_3O_8, ThO_2, or PuO_2. The assembly is placed on a mandrel and hot-swaged at 550 to 600°C to reduce cross section by 35 to 55% and bond the core and sheath. (P.G.C.)

Corrosion and Erosion

Refer also to abstracts 25234, 25235, 25327, 25374, 26080, and 27418.

26026 (CEA-N-616, pp 106–44) ETUDES DE CORROSION. (Corrosion Studies). (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Developments are reported for studies on: physicochemistry of corrosion of nuclear materials; stainless steels and nickel alloys; weakly alloyed steels; Al–Fe alloys; Zr alloys; light alloys; technological studies on steels; storage of fuel elements; and models of fuel elements. (P.C.H.)

26027 (GEAP-5495) INVESTIGATION OF INTERGRANULAR CRACKING OF NONSENSITIZED AUSTENITIC STAINLESS STEELS IN CIRCULATING AUTOCLAVES. Pickett, A. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). June 1967. - Contract AT(04-3)-189. 36p. (EURAEC-1970). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The effect of environmental variables (temperature, pH, chemical concentration, dissolved oxygen, and cation and anion species) on intergranular cracking of austenitic stainless steel was studied. Low pH, chloride ions, and high stress were found to promote intergranular cracking of nonsensitized austenitic stainless steels. Dissolved oxygen was not necessary. An accelerated test environment, 650°F 0.1-g/l $FeCl_2$ solution, was developed which simulates the intergranular attack on austenitic stainless steel fuel cladding surfaces. The results of tests to determine the relative intergranular susceptibility of various AISI austenitic steels and European austenitic and austenitic-ferritic steels are reported. For the alloys tested, the only significant compositional effect was less susceptibility for the higher nickel alloys. Machined surfaces showed less susceptibility than as-drawn or electropolished surfaces. The only significant effect of irradiation to 7,000 to 10,000 MWd/tU in the Vallecitos Boiling Water Reactor (VBWR) on intergranular susceptibility appeared to be that of increasing the attainable applied stress for mill-annealed tubing, thereby increasing its susceptibility. The intergranular susceptibility of irradiated type-304 stainless steel VBWR fuel cladding was compared with that of irradiated type-348 stainless steel Yankee fuel cladding. The type-304 cladding was, at most, a factor of 2 more susceptible than comparable type-348 cladding in the test. (auth)

26028 (NYO–3839-5, Paper 6) INTERACTION OF OXYGEN WITH A THORIUM COVERED TUNGSTEN SURFACE. Estrup, P. J.; Anderson, J. (Bartol Research Foundation, Swarthmore, Pa.). 14p.

Thorium was deposited on a tungsten surface and the structural changes caused by subsequent oxygen adsorption were observed. As oxygen adsorbs a series of well-defined surface structures are formed. It was therefore concluded that the oxygen adsorption proceeds in a highly regulated manner and also that the initial $C(2 \times 2) - Th$ structure remains essentially unchanged during the interactions. Changes consistent with ThO_2 formation were observed. Subsequent desorption of the oxygen could not regenerate the original thorium structure. (M.C.G.)

26029 (ORNL–4229, pp 71–83) CORROSION AND CHEMICAL BEHAVIOR IN REACTOR AND DESALINATION ENVIRONMENTS. (Oak Ridge National Lab., Tenn.).

Research progress is reported on: hermetically sealed pressurized- and boiling-water reactors, water chemistry in a small state-of-the-art pressurized-water, water radiolysis in the HFIR, anodic film growth on metals at elevated temperatures, corrosion support for the High-Flux Isotope Reactor, corrosion of titanium in saline waters, effect of sulfide on corrosion in saline waters, carbon dioxide scale suppression studies, and the OSW Materials Information Center. (M.C.G.)

Preparation and Fabrication

Refer also to abstracts 25235, 25323, 25578, 25623, 26050, and 27452.

26030 EFFECT OF ELECTROSPARK ALLOYING WITH REFRACTORY COMPOUNDS OF TRANSITION METALS ON NOTCH TOUGHNESS. Safronov, I. I.; Struk, L. I.; Morozov, V. A. Elektron. Obrab. Mater., No. 4, 80-3(1966). (In Russian).

Impact test specimens of carbon steel St. 45 with standard dimensions (10 × 10 × 50 mm) but with a round notch (5 mm radius, 2 mm deep) were ground to a high-quality finish and electrospark alloyed with some refractory compounds. In specimens alloyed with zirconium nitride, carbide, or diboride, the notch toughness increased considerably with increasing discharge power due to the increased depth of the heat-affected zone. In specimens alloyed with niobium or chromium carbide, the increase was much less pronounced because of the low ductility of the alloyed layer. In specimens alloyed with titanium diboride, T15K6 alloy, or boron carbide, the notch toughness dropped with increasing discharge power, also due to a reduced ductility. All the specimens retained high surface microhardness with increasing notch toughness. (ATD)

26031 THE INITIAL STAGE OF ELECTRODEPOSITION OF TUNGSTEN ALLOYS BY USING RADIOISOTOPE ^{185}W. PART V. STUDIES OF ELECTRODEPOSITION OF TUNGSTEN ALLOYS. Kudo, Toshiyuki. Kinzoku Hyomen Gijutsu, 17: No. 7, 7-9(1966). (In Japanese).

The determination of a trace amount of W alloys in the initial stage of electrodeposition was studied by using radioisotope ^{185}W as tracer. The counting of ^{185}W was observed at a cathode potential of 20 to 40 mV earlier than the first apparent deposition. When the electrolyte was composed of W salt only, lower tungsten oxide was reduced at the cathode and the reduction was promoted by the

addition of hydrazine sulfate. However, the reduction was decreased by the addition of supporting electrolytes such as tartrate and citrate. Accordingly, the supporting electrolytes had no direct effects on the reduction of W ion, but they formed effective complex salts with Fe, Co, Ni, etc. (Rev. Metal Lit.)

26032 MACHINING OF NUCLEAR MATERIALS. Wright, W. J. Aust. Mach. Prod. Eng., 19: 21-5; 27; 29-31; 33; 35 (Dec. 1966).

The hazards encountered in machining U, Th, Pu, Be and Zr are described: radioactivity, toxicity and pyrophoricity. Handling procedures for the control of these hazards are summarized. Equipment for machining these materials is described and illustrated. Machining behaviors of metals, uranium oxide and beryllium oxide are discussed. Typical machining conditions are tabulated for U, Th, Be and Zr; Pu machines similarly to U. The effects of machining on the mechanical behavior of these materials in service are illustrated by specific examples. Machined Zr surfaces corrode more rapidly than etched or annealed surfaces. Machined Be metal may have 30 to 40% lower strength than etched or annealed Be. The effect of machining on mechanical behavior and surface structure of beryllium oxide is discussed. (Rev. Metal Lit.)

26033 TO MUFFLE A NUCLEAR ROCKET ENGINE: WELDED STAINLESS. Weld. Eng., 51: No. 12, 84-5(Dec. 1966).

The exhaust system for a nuclear rocket engine consists of a double-walled stainless steel duct with welded angles and tubes forming coolant water channels. Primary and secondary sections are 0.095-in. thick type 347 stainless with low phosphorus and low sulfur content. The exterior wall is made up of a series of stainless angles welded around the periphery of the inner shell. Continuous Tig welds were used on all interior surfaces, while Mig and Tig welds were used on the exterior surfaces. Automatic and semiautomatic welding techniques were used. (Rev. Metal Lit.)

26034 PROCESS FOR IMPROVING THE PROPERTIES OF BERYLLIUM-BASE ALLOYS. Belangere, Lucien; Dufaux, Daniel; Mallen-Herrero, Jose Maria; Weisz, Michel (to Commissariat a l'Energie Atomique). British Patent 1,107,446. Mar. 27, 1967. Priority date May 14, 1965, France.

Mechanical strength and creep resistance characteristics of cast Be alloys are increased by swaging the extruded ingot in an iron, mild steel, or Cu jacket between 400 and 700°C and annealing at a temperature higher than the recrystallization temperature of the alloy. (P.G.C.)

26035 METAL PLATING PROCESS AND ARTICLE MADE THEREBY. Otto, Milton C. (to Union Carbide Corp.). U. S. Patent 3,368,951. Feb. 17, 1964.

Plating nickel onto a zirconium or thorium substrate from a nickel plating bath which is an aqueous solution consisting of 20 to 50 g/l nickel sulfate; 6 to 12 g/l zirconium sulfate; 10 to 30 g/l sodium hypophosphate; 10 to 30 g/l sodium acetate; and 10 to 30 g/l sodium citrate is described. In plating the metal zirconium or thorium the metal is cleaned and immersed in the metal plating bath which is maintained at 85 to 100°C. While the metal is immersed in the bath, a voltage of 1 to 50 volts dc is applied between an anode and the metal zirconium or thorium acting as a cathode. The voltage is applied for 1 to 5 seconds to initiate the reaction. In making insert electrodes of the invention after the nickel coating is formed on the insert metal, such insert is brazed to the metal holder which may be copper, silver, aluminum, brass, or steel. (J.C.W.)

Properties Evaluations

Refer also to abstracts 25334, 27396, 27448, 27449, 27458, and 27479.

26036 (BMI-1836) INVESTIGATION OF THE INITIATION AND EXTENT OF DUCTILE PIPE RUPTURE. Quarterly Progress Report, January-March 1968. Eiber, Robert J.; Maxey, Willard A.; Duffy, Arthur R.; Atterbury, Thomas J. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1968. Contract W-7405-eng-92. 14p. Dep. CFSTI.

Theoretical formulations for predicting the failure pressure of through-wall and surface-flaw defects are examined for their ability to predict the failure pressure of various defect sizes. Three full-scale experiments were conducted which include: one experiment with 24 in.-OD Schedule 100 A106B pipe, and two experiments with 24 in.-OD Schedule 40 A106B pipe. Strain gage results are presented. (auth)

26037 (CONF-660706-, pp 91-103) EVALUATION OF A PLASTIC FOAM MAGAZINE FOR HANDLING NUCLEAR FUEL. Jensen, H. F. (Washington State Univ., Pullman).

The development and evaluation of a plastic fuel handling magazine are discussed. Nuclear safety precluded the use of a solid plastic. A foamed plastic was required to improve wear and usage as well as providing the necessary strength and rigidity. The testing of the various prototypes is described. (M.C.G.)

26038 (GEAP-5395) A THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES. Quarterly Report No. 2. Aitken, E. A.; Evans, S. K. (General Electric Co., Pleasanton, Calif. Nucleonics Lab.). Feb. 1968. Contract AT(04-3)-189. 10p. Dep. CFSTI.

Thermal arrest measurements were obtained on sealed tungsten capsules containing plutonia in the O-to-Pu range of 1.73 to 2.00. The melting temperature was found to increase gradually with decreasing O-to-Pu ratio. The liquidus and solidus temperatures were very close together. The results show striking similarities with hypostoichiometric mixed oxide compositions and dissimilarities with hypostoichiometric urania compositions. (auth)

26039 HYDROGEN EMBRITTLEMENT OF METALS. Rogers, H. C. (General Electric Co., Schenectady, New York). Science, 159: 1057-64(Mar. 8, 1968).

The mechanisms by which hydrogen interacts with many metals to reduce their ductility and frequently their strength is discussed. It enters metals in the atomic form, diffusing very rapidly even at normal temperatures. During melting and fabrication, as well as during use, there are various ways in which metals come in contact with hydrogen and absorb it. The absorbed hydrogen may react irreversibly with oxides or carbides in some metals to produce a permanently degraded structure. It may also recombine at internal surfaces of defects of various types to form gaseous molecular hydrogen under pressures sufficiently high to form metal blisters when the recombination occurs near the outer surface. In other metals, brittle hydrides that lower the mechanical properties of the metal are formed. Another type of embrittlement is reversible, depending on the presence of hydrogen in the metal lattice during deformation for its occurrence. Under some conditions the failure may be delayed for long periods. A number of different mechanisms have been postulated to explain reversible embrittlement. According to some theories hydrogen interferes with the processes of plastic deformation in metals, while according to others it enhances the tendency for cracking. (auth)

26040 INFLUENCE OF THE ANNEALING TEMPERATURE ON Q^{-1} AND G OF PURE CHROMIUM AND OF ALLOYS OF CHROMIUM WITH YTTRIUM AND GADOLINIUM. Belous, O. A.; Gridnev, V. N.; Efimov, A. I.; Mil'man, Yu. V.; Trefilov, V. I. pp 58-63 of Internal Friction in Metals and Alloys. Postnikov, V. S.; Tavadze, F. N.; Gordienko, L. K. (eds.). New York, Consultants Bureau, 1967.

The low-temperature and high-temperature internal friction characteristics of zone-refined Cr, and of Cr-Gd and Cr-Y alloys were investigated by the torsional vibration method. (P.G.C.)

26041 FATIGUE LIMITS OF CERTAIN REFINED ALLOY STEELS. Bernath, Alexandru; Horovitz, Bernanrd; Sos, Ludovic. Constr. Masini, 18: 65-75(1966). (In Rumanian).

Fatigue limits were studied in certain 41MoC11 steel melts containing 0.39-0.42% C, 1.0-1.22% Cr, 0.04-0.17% Ni and 0.2-0.3% Mo; in 40C10 containing 0.35-0.45% C, 0.8-1.05% Cr and 0.99-0.14% Ni; and in 40CN12 containing 0.4-0.42% C, 0.5-0.74% Cr and 1.10-1.5% Ni, after hardening and tempering at 500 and 600°C for 41MoC11 and 40C10 steels and 540 and 600°C for 40CN12 steels. The experimental data were analyzed and examples of calculations related to fatigue strength are given. (Rev. Metal Lit.)

26042 INVESTIGATION OF THE HEAT RESISTANCE AND THERMOCYCLIC FATIGUE OF REFRACTORY METALS BY THE INTERNAL FRICTION METHOD. Aleksandrov, L. N.; Mordyuk, V. S. pp 72-8 of Internal Friction in Metals and Alloys. Postnikov, V. S.; Tavadze, F. N.; Gordienko, L. K. (eds.). New York, Consultants Bureau, 1967.

Results of an investigation of changes in the peaks of internal friction during the process of fracture of W monocrystals at 1500°C and under a stress of $\sigma = 6.45$ kg/mm^2 are reported. It was noted that high-temperature deformation increased both the overall high-temperature background, as well as the individual relaxation maxima in the temperature range 700 to 2500°C. Enhancement of dislocation and grain boundary peaks was also observed. (P.G.C.)

26043 EVALUATION OF THE TENDENCY OF THIN SHEETS TOWARD BRITTLE FRACTURE. Abramovich, M. D.; Gol'tsev, V. Yu.; Drozdovskii, B. A. At. Energ. (USSR), 23: 557-8(Dec. 1967). (In Russian).

Use of 0.3 to 0.5 mm thick sheets as structural material in heterogeneous reactors presents advantages in view of their

high resistance against attack by corrosive media, high temperature, and high neutron flux; however, these sheets are known to be subject to brittle fracture. This behavior prevented the use of sheets made of certain types of steels. A method was developed to evaluate the tendency toward brittle fracture using an impact bending test. For specimens cut from 0.3 to 0.5 mm thick sheets, the ferritic and austenitic steel specimens with a crack were tested while held in a vise at −196 to 600°C. It was found that the critical temperature of the 0.4 mm thick ferritic EP-142 steel specimens lies between −140 and −196°C; at −140°C the fracture is ductile exhibiting the same values as room temperature but at −196° the material is completely embrittled. For the austenitic EP-150 steel no changes were noted down to −196°C. The critical temperature of similar samples dimensions of 10 × 11 × 60 mm was about 100°C; an attempt was made to determine the reason for the sudden drop of the physical temperature. The dimensions of the same specimens changed to 3 × 0.85 × 0.4 mm resulted in a physical temperature of 140°C. It was concluded that the main cause of the reduction of the critical temperature is due to the decrease of the stress volume. Austenitic steels are less sensitive than the ferritic ones. A critical temperature of cold-rolled steel is lower than that of forged material of the same dimension. (TTT)

26044 ANALYSIS OF EXPERIMENTAL DATA ON VISCOSITY AND SELF-DIFFUSION OF LIQUID METALS AND THEIR CORRELATION BY A SIMPLE KINETIC THEORY OF LIQUIDS. Grosse, A. V. (Temple Univ., Philadelphia). Contract AT(30-1)-2082. Rev. Int. Hautes Temp. Refract., 4: 171-82(July-Sept. 1967). (NYO-2082-9).

An analysis of experimental data on viscosity and self-diffusion of liquid metals and their correlation by a simple kinetic theory of liquids is presented. Experimental viscosity and self-diffusion data of 28 and 9 liquid metals, respectively, are analyzed. It is shown that if their η and D_{iff} equations are expressed in a self-consistent manner, i.e., that the Stokes–Einstein relation (in its Eyring version) is satisfied, or that: $\eta \cdot D_{iff} = (k \cdot T/6 \cdot \sigma) = [k \cdot T(N_{avog})^{1/3}/6 \cdot (V_{at})^{1/3}]$ viscosity can be calculated from self-diffusion and vice versa. The calculated values show, in most cases, good agreement with the experimental data. In the past, the η data for Hg, Na and K were extrapolated to the critical region using liquid argon as a model. Data on the reduced diffusion coefficients of liquid argon, from melting point to critical point, are presented; they can now be used to estimate D_{iff} of liquid metals to their critical region. (auth)

26045 GAS BUBBLES IN SOLIDS. Lidiard, A. B.; Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 17: 425-9(Feb. 1968).

It is pointed out that, as a consequence of the distinction in solids between surface tension γ and surface energy σ, a strain field generally exists around gas bubbles even in thermodynamic equilibrium. The existence of this strain field leads to a small attraction between bubbles, but in typical practical situations this is only significant for bubble migration when the bubbles are close together compared to their radii. The study was conducted in connection with fission gases in nuclear fuels. (auth)

26046 STUDY OF THE FAILURE BEHAVIOR OF FILAMENTARY REINFORCED METAL MATRICES. Tsang, S.; Martin, G. (North American Aviation Inc., Los Angeles, Calif.). pp 371-411 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

An experimental study was made of the failure behavior of tungsten fiber–titanium alloy filamentary composite specimens and the comparison of the experimental results with various theoretical approaches. Deformation studies were carried out by radiographic observation of the incrementally stressed specimens, strains being measured by platinum wire markers embedded in the composite during fabrication. Strains in all fibers and the composite were alike and not affected by the presence of a diffusion layer. Radiographs indicate that there is no fracturing of fibers at loads up to 98.5% of the failure load. Failure appears to occur by failure of the matrix following ductile fracture of the inherently brittle fibers. Electron microscope fractography of fracture surfaces shows that the inherently ductile matrix has broken with a quasicleavage fracture, indicating a rapidly propagating failure crack. These results indicate mutual restraints between fibers and matrix in the composite. (auth)

26047 THERMAL CONDUCTIVITY OF HOT PRESSED BERYLLIUM BLOCK. Tye, R. P. (Dynatech Corp., Cambridge, Mass.); Quinn, J. E. pp 144-9 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

In the design of the SNAP and other space systems, great emphasis is placed upon weight and, therefore, upon high strength to weight ratio materials such as beryllium. Results are presented for the thermal and electrical conductivities of the widely used hot-pressed block form of this metal over the temperature range from 293 to 875°K. Comparison with other values is presented. The question of anisotropic behavior due to pressing direction was also investigated with the results that there is no apparent anisotropic behavior in either transport property. (auth)

26048 ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM AT EXTREMELY HIGH TEMPERATURES. Kirillin, V. A.; Sheindlin, A. E.; Chekhovskoy, V. Ya.; Petrov, V. A. (Academy of Sciences, Moscow). pp 54-7 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

Experimental data on the enthalpy of molybdenum have been obtained by a drop technique for extremely high temperatures ranging from 1000 to 2850°K. Intensive increase in enthalpy and heat capacity has been found near the melting point of molybdenum, due to vacancies' contribution. Formation energy and vacancies concentration at the melting point have been calculated. Empirical equations for calculating the enthalpy and heat capacity of molybdenum are proposed for temperature range of 1000 to 2890°K. Molybdenum is recommended as a reference substance in high temperature calorimetry for the temperature range of 1000 to 2000°K. (auth)

26049 INFLUENCE OF CARBIDE AND BORIDE ADDITIONS ON THE CREEP STRENGTH OF NIOBIUM ALLOYS. McAdam, G. D. (Group Research Centre, Birmingham, Eng.). J. Inst. Metals, 96: 13-16(Jan. 1968).

The effects of metallic carbides and borides on the strength of Nb–W alloys, and of ternary alloys with Ta, were studied at temperatures close to 0.5 T_m. Alloys were warm forged, solution-treated, and creep-tested in a vacuum at high stresses. The stable precipitates contained little or no W or Ta, and this was taken into account in evaluating the creep-rupture properties, in terms of the amount and constitution of the added compounds. Hafnium carbide at a concentration of ~2 mol. %, was the most effective addition, and other compounds had effects in line with their absolute melting points. A ratio of metal to non-metal of 1.3 gave the best properties. The several variables were considered in an empirical creep–rate equation; in favourable conditions this gave a hyperbolic sine stress-dependence, the basis of a new equation for the prediction of the 100 hr rupture stress. (auth) (UK)

26050 INCONEL 625: AN ALLOY FOR STEAM AND GAS TURBINES. Barker, James F.; Cox, Joseph D.; Margolin, Eli (General Electric Co., Evendale, Ohio). Metal Progr., 93: 91-4(Apr. 1968).

Inconel 625 is being used in gas turbines for aircraft. The metallurgical, mechanical, and fabrication properties of Inconel 625 are reviewed. It is concluded that Inconel 625 has good workability and can withstand high-temperature exposures. (D.L.C.)

26051 TUNGSTEN. Tungsten News, June 1967. New York, Climax Molybdenum Co., 1967. 18p.

The literature on preparation, properties, and uses of W, WC, W-compounds, and W-base alloys is reviewed. Information is given on brazing, welding, cladding, coating, and machining. 198 references. (P.G.C.)

26052 TUNGSTEN. Tungsten News, March 1968. New York, Climax Molybdenum Co., 1968. 17p.

Technology and uses of W, W-base alloys, compounds, and carbides are reviewed. Topics discussed include preparation, ore processing, machining, ultrasonic inspection of products, vapor deposition, crystal structure, coatings, and metallurgy of W-high-speed steels. 193 references. (P.G.C.)

Structure and Phase Studies

Refer also to abstracts 26762, and 26764.

26053 (INR-871/XIV/PS) BADANIA METALOGRAFICZNE, TWARDOSCI I RENTGENOGRAFICZNE STOPU O SKLADZIE Nb–25–30 PERCENT Sn, PO OBROBCE CIEPLNEJ OTRZYMANEGO NA DRODZE METALURGII PROSZKOW. (A Study in Metallography Hardness and Structural Rentgenography of Pow-

der Metallurgy; Nb–25–30 percent Sn Alloys After Heat Treatment). Rutkowski, W.; Horubala, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 20p. (In Polish). Dep.

Nb–Sn alloy specimens containing Nb_3Sn and Nb phases were investigated after heat treatment. It can be stated, that the Nb_3Sn phase is stable at 20 to 1100°C. The results obtained agree with the works of Sawicki et al., Ellis et al., and Kogen et al., but differ from results obtained by Wyman et al. and Reed et al. (auth)

26054 (IS–1752) COMPILATION OF THORIUM BINARY PHASE DIAGRAMS. Carlson, O. N.; Stevens, E. R. (Ames Lab., Iowa). Jan. 1968. Contract W-7405-eng-82. 115p. Dep. CFSTI.

The known phase diagrams and crystallographic data for the intermediate phases for 63 binary systems of thorium have been compiled. A brief discussion together with a complete bibliography for each system is included. The compilation is based on a literature survey through 1967 and supplements the more selective and condensed version summarized in a section of the forthcoming third edition of the Reactor Handbook on Materials. (auth)

26055 (NLCO–988) STRUCTURAL CHANGES ASSOCIATED WITH HIGH-TEMPERATURE DEFORMATION OF URANIUM. Rhines, F. N. (Florida Univ., Gainesville). Apr. 1968. Contract AT(30-1)-1156. 109p. Dep. CFSTI.

A method of producing test bars of μ-base alloys was used to preserve the microstructure that exists during hot working. Using this method tensile bars of U and dilute U alloys with Si, Fe, Al, and C were strained and quenched according to a program which provided temperature ranges at 300 to 600°C, strain rates at 0.009 to 0.75/min, and extent of strain at 0 to fracture. From these tests a measure of the strain to fracture was obtained. The microstructure of each specimen was analyzed by metallography. Results indicate that unidirectional tensile strain does not lead to grain boundary shearing in U at any temperature. Thermal fluctuations are capable of producing intergranular fissures in U of the kind that appear in other metals during high temperature creep. (J.R.D.)

26056 (NYO–3830–5) CHEMISORPTION STUDIES BY LEED. Final Report. Danforth, W. E. (Bartol Research Foundation, Swarthmore, Pa.). Mar. 29, 1968. Contract AT(30-1)-3830. 79p. Dep. CFSTI.

Studies are being made of the interaction of simple atoms and molecules with transition metal surfaces employing the techniques of low-energy electron diffraction (LEED). Reprints and preprints included are: thorium layers on tungsten (100), structure and LEED intensities; LEED observations of epitaxially grown thorium on (100) tantalum; problem of adsorbate arrangement in the W(100) $(1 \times 4) - (N + CO)$ structure; surface structures and work function changes in oxygen adsorption on tungsten; effects of electrons on NH_3 adsorbed on a W(100) surface; adsorption and decomposition of ammonia on single-crystal tungsten (100) surface; and interaction of oxygen with thorium-covered tungsten surface. Separate abstracts were prepared for three of the attached papers. (M.C.G.)

For abstracts of individual papers see: 26028, 26057, and 26062.

26057 (NYO–3830–5, Paper 3) LEED OBSERVATIONS OF EPITAXIALLY GROWN THORIUM ON (100) TANTALUM. Pollard, J. H.; Danforth, W. E. (Bartol Research Foundation, Swarthmore, Pa.). 9p.

The growth of thorium overlayers on (100) tantalum at 950°C was studied to a depth of 20 monolayers by LEED. The thorium initially forms an incomplete $c(2 \times 2)$ structure, in 'islands', up to a density of 3×10^{14} atoms/cm^2. Thereafter the 2D LEED pattern shows that the thorium layers have (1×1) registry with the tantalum substrate up to a density of 1.8×10^{15} atoms/cm^2. The pseudomorphism is discussed in terms of strongly distorted planes occurring in the bcc and fcc allotropes of bulk thorium. (auth)

26058 (RFP–1104) MOUNTING MATERIALS AND ALUMINA FOR EDGE RETENTION IN PREPARING METALLOGRAPHIC SPECIMENS. Calabra, A. E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Apr. 2, 1968. Contract AT(29-1)-1106. 10p. Dep. CFSTI.

Excellent edge retention can be maintained on metallographic specimens by the addition of pelletized alumina mounting filler to metallographic mounting materials. By this addition to the mounting material, specimen preparation, which previously had been extremely difficult, has now become routine. (auth)

26059 (AD–663333) PHASE DIAGRAMS OF SYSTEMS OF HYDROGEN WITH TITANIUM, ZIRCONIUM, VANADIUM, AND NIOBIUM. Samsonov, G. V.; Antonova, M. M. Translated from Uk. Khim. Zh., 32: 555–9(1966). 14p. (FTD-HT-23-925-67). CFSTI.

Phases of the systems titanium–hydrogen, zirconium–hydrogen, vanadium–hydrogen, and niobium–hydrogen with compositions ranging from no hydrogen to $TiH_{1.93}$, ZrH_2, $VH_{0.915}$, and NbH at room temperature were studied by x-ray diffraction. The distribution of the phase regions in the four systems is shown. It is apparent that the lower boundaries of the region of homogeneity of the β phase are shifted in a regular manner toward a lower hydrogen content on passing from titanium to niobium; this corresponds to the increase in the filling of the d-subshell of the corresponding transition metals. A satisfactory agreement between x-ray and pycnometric density values was found for the Zr–H and Nb–H systems; the discrepancy of these values in the Ti–H system is attributed to the fact that the hydrides studied were not in a state of equilibrium. (auth)

26060 ERBIUM–ALUMINUM AND YTTRIUM–ALUMINUM SOLID SOLUTIONS. Meyer, A. (Siemens AG., Munich). J. Less-Common Metals, 15: 235–6(June 1968). (In German).

In connection with a Moessbauer investigation, the problem of determining the structural differences between $MgCu_2$-type crystals and the Laves phases of $ErAl_2$ and YAl_2 was checked. Data are tabulated on the lattice constants and melting points of $Er_xY_{1-x}Al_2$ solid solutions. (J.R.D.)

26061 PHASE EQUILIBRIA AND SUPERCONDUCTIVITY IN THE MOLYBDENUM–PLATINUM SYSTEM. Ocken, H.; van Vucht, J. H. N. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals, 15: 193–9(June 1968).

The phase diagram of the Mo–Pt system was determined by x-ray diffraction methods, metallographic techniques, and the direct observation of melting phenomena. Seven single-phase regions were observed: terminal bcc Mo solid solution, A15 (β-W)-type Mo_3Pt, disordered hcp Mg type, ordered Mg_3Cd type Mo_3Pt_2, orthorhombic MgCd-type MoPt, orthorhombic $MoPt_2$ and a terminal fcc Pt solid solution. Particular attention was paid to the nature of formation of the A15 phase. (auth)

26062 THORIUM LAYERS ON W(100); STRUCTURE AND LEED INTENSITIES. Estrup, P. J.; Anderson, J. (Franklin Inst., Swarthmore, Pa.). Surface Sci., 7: 255–8(1967). (NYO–2730–67; NYO–3830–5(Paper 2)).

Deposition of thorium on tungsten beyond a monolayer lead to the formation of a close-packed structure that has only a weak crystallographic relationship with the tungsten lattice. Based on the LEED (low-energy electron diffraction) pattern, a hexagonal close packed structure was assigned to the thorium layers. It is shown that a relatively small number of structural imperfections may inhibit the long-range dynamical effects without appreciably changing the LEED pattern. (M.C.G.)

26063 INVESTIGATION OF THE BEHAVIOR OF INTERSTITIAL ATOMS IN MOLYBDENUM BY THE INTERNAL FRICTION METHOD. Piguzov, Yu. V.; Verner, V. D.; Shulepov, V. I.; Rzhevskaya, I. Ya. pp 15–17 of Internal Friction in Metals and Alloys. Postnikov, V. S.; Tavadze, F. N.; Gordienko, L. K. (eds.). New York, Consultants Bureau, 1967.

The temperature dependence of internal friction in Mo was determined on heat treated and deformed Mo sheet containing Fe, P, C, O_2 and N_2 impurities. For quenched samples a broad internal friction peak of complex form was located in the 60 to 400°C range. The maximum amplitude of the peak increased with increase in quenching temperature. Correlation between internal friction and concentration of interstitial impurities in the Mo solid solution is shown graphically. (P.G.C.)

26064 INTERNAL FRICTION IN METALS AND ALLOYS. Postnikov, V. S.; Tavadze, F. N.; Gordienko, L. K. (eds.). New York, Consultants Bureau, 1967. 274p. $27.50.

Translation of Vnutrennee Trenie v Metallakh i Splavakh by Albin Tybulewicz.

A total of forty-eight papers are presented. A separate abstract was prepared for each of six of these. Papers for which no abstracts were prepared are concerned with internal friction in pure metals and nonmagnetic alloys, internal friction in steels, effects of vibration on materials, measurement of internal friction, and theory of internal friction. (P.G.C.)

For abstracts of individual papers see: 25577, 26040, 26042, 26063, 26068, and 26086.

Radiation Effects

Refer also to abstract 26452.

26065 (TRG-Report-1353) A REVIEW OF THE LIKELY FATIGUE BEHAVIOUR OF IRRADIATED STAINLESS STEEL ETC. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields (England). Reactor Group). Oct. 3, 1966, Reprinted 1968. 10p. Dep. CFSTI. UK 1s. 9d.

Differential expansion of the stainless-steel cladding and the UO_2 which it contains may occur when cyclic variations in power are produced in certain types of nuclear reactors. Cyclic plastic strains can result and so the fatigue endurance of stainless steel and similar materials under neutron irradiation is of interest. As few data are available, these have been generalized and supplemented by a theory of deformation and fracture which derives independent support from other related phenomena such as out-of-pile fatigue and the irradiation-induced reduction in rupture ductility. (auth)

26066 (UJV-1931) VLIV NEUTRONOVEHO SPEKTRA NA RADIACNI ZPEVNENI OCELI PRO TLAKOVE NADOBY. (The Influence of Neutron Spectra on Radiation Effects in a Steel Pressure Vessel). Cervasek, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Dec. 1967. 41p. (In Czech). Dep.

Carbon and low alloy steels were irradiated in two different reactor positions. Tensile test and hardness data show that with an equal dose (E > 1 MeV) a somewhat greater (10–15%) hardening was obtained in the softer spectrum than in the harder one. Using calculated neutron spectra for two reactor positions and difference of hardening, an attempt was made to compare several radiation damage models. A cascade model (Kinchin & Pease) and several modifications of a depleted zone model (Seeger) were taken into consideration. The depleted zone model gave results more in accordance with the experiments (15.2%) than the cascade model (7.6%). The difference between the spectra of two reactor positions is too small to allow the accuracy of separate modifications of depleted-zone model to be assessed. (auth)

26067 LOW-TEMPERATURE ANNEALING SPECTRUM OF MAGNESIUM FOLLOWING ELECTRON IRRADIATION. O'Neal, T. N.; Chaplin, R. L. (Clemson, Univ., S. C.). Contract AT(40-1)-3098. Phys. Lett., 26A: 453-4(Apr. 8, 1968). (ORO-3098-5).

High purity polycrystalline magnesium samples near 4.2°K have been irradiated with 0.4 and 0.3 MeV electrons. Subsequent isochronal recovery was observed to occur in two stages: one centered near 6.8°K and the other centered near 11.4°K. (auth)

26068 INVESTIGATION OF SOME RADIATION DEFECTS IN METALS BY THE METHOD OF MEASURING INTERNAL FRICTION AND YOUNG'S MODULUS. Pokrovskii, Yu. I.; Vikhrov, V. I.; Perevezentsev, V. N. pp 79-84 of Internal Friction in Metals and Alloys. Postnikov, V. S.; Tavadze, F. N.; Gordienko, L. K. (eds.). New York, Consultants Bureau, 1967.

The influence of small ($1.0 \cdot 10^{14}$ neutrons/cm^2) and large ($1.0 \cdot 10^{20}$ neutrons/cm^2) doses of neutron radiation on Young's modulus and internal friction of annealed Cu, Mo, and W was investigated at flexural vibrations of 200 to 300 cps. It was found that both internal friction phenomena and Young's modulus were sensitive to neutron irradiation and might be used to investigate various radiation defects in metals. (P.G.C.)

Ceramics and Cermets

Refer also to abstracts 25462, 26025, and 27487.

26069 PROGRESS IN CERAMIC SCIENCE. VOLUME 4. Burke, J. E. (ed.). New York, Pergamon Press, Inc., 1966. 283p. $14.00.

Five reviews of important topics in ceramics are included: radiation effects in quartz, silica and glasses; pressure sintering of ceramics; properties of magnetic compounds in connection with their crystal chemistry; growth of single crystals from nonstoichiometric melts; and electrical conduction mechanisms in oxides. A separate abstract was prepared on each of three reviews–those concerning radiation effects, pressure sintering, and single-crystal growth. (D.L.C.)

For abstracts of individual papers see: 26079, 26089, and 26095.

Corrosion and Erosion

Refer also to abstract 25327.

26070 (ORNL-4229, pp 119-24) OXIDATION OF CARBONACEOUS MATERIALS BY WATER VAPOR. Overholser, L. G. (Oak Ridge National Lab., Tenn.).

Reactions of bonded coated-particle fuel compacts with steam, reaction of pyrolytic-carbon-coated fuel particles with water vapor, and reactions of needle-coke graphite with steam were studied. (M.C.G.)

Preparation and Fabrication

Refer also to abstracts 25585, 25586, 25591, 27423, 27489, 27506, 27507, and 27512.

26071 (MLM-1450) THE PREPARATION OF ^{238}Pu DIOXIDE MICROSPHERES BY THE SOL-GEL PROCESS. Plymale, D. L.; Smith, W. H. (Mound Lab., Miamisburg, Ohio). Sept. 30, 1967. Contract AT(33-1)-Gen-53. 7p. Dep. CFSTI.

The preparation of $^{238}PuO_2$ microspheres by the sol-gel process was evaluated. This process requires three major operations: the preparation of an aqueous sol, the removal of water to give a solid gelled microsphere, and the calcination of the gelled microsphere at 1200°C. Reproducible sols and microspheres were obtained on a laboratory scale, and various experimental parameters were studied. (auth)

26072 (NP-17350) OBTENCION DE UO_2 EMPLEANDO COMO REDUCTOR EL NH_3 DISOCIADO. (Obtaining UO_2 by Use of Cracked Ammonia as Reducing Agent). Ruiz Garcia, Marusa (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica). 1967. 69p. (In Spanish). Dep. Thesis.

The cracking of NH_3 and use of the cracking products for reduction of U_3O_8 are considered theoretically. Optimum conditions for the cracking of NH_3 were determined experimentally. Results showed that the use of fibrous Fe as a catalyst yields very favorable results. The efficiency of the production of UO_2 by use of cracked ammonia is approximately 100%. (J.S.R.)

26073 (ORNL-TM-2205) LABORATORY AND ENGINEERING STUDIES OF SOL-GEL PROCESSES AT OAK RIDGE NATIONAL LABORATORY. Wymer, R. G. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 63p. Dep. CFSTI.

A brief description of a model for sols, based largely on studies on ThO_2 sols, is given. Processes based on solvent extraction of nitrate ions by secondary amines to prepare ThO_2-UO_3 and UO_2 sols are discussed, and the flowsheets and equipment used in preparing these sols are illustrated. A method suitable for preparing 150 g batches of PuO_2 as sol is described, along with the properties of the typical PuO_2 and UO_2-PuO_2 products. Demonstrated processes for preparing, drying, and firing microspheres of ThO_2, ThO_2-UO_2 are described, and results of some experiments on low-energy compaction of microspheres in tubes to form fuel elements of predetermined density are discussed. Finally, miscellaneous sol-gel processes for preparing carbides, porous oxides, nitrides, and carbonitrides are briefly described. (auth)

26074 (SCNC-331) DIRECT PREPARATION OF URANIUM-CARBIDE FROM URANIUM FLUORIDE. Reznik, Barry D.; Powers, Richard M. (Sylvania Electric Products Inc., Bayside, N. Y. Sylcor Div.). Aug. 1961. Contract AT(30-1)-Gen-366. 42p. Dep. CFSTI.

The feasibility of a new and potentially low-cost route to uranium monocarbide was demonstrated on a 50 gram scale in a fixed bed reactor. The reaction, $UF_4 + Si + C \rightarrow UC + SiF_4$, proceeds readily at 1500 to 1700°C. Pelletized reactants are heated by induction in a graphite boat. The reaction, which may be followed by silicon tetrafluoride evolution, is completed in one hour or less and yields pellets that may be crushed to nonpyrophoric uranium carbide powder or arc melted to yield massive uranium carbide. Uranium carbide powder was produced with residual silicon contents as low as 0.01%; fluoride, 0.011%; oxygen, 0.04%; and nitrogen, 0.011%. Carbon contents of individual experiments usually ranged from 4.5 to 5.5% in most runs. Products from some of these runs resulted in approximately single-phase uranium monocarbide on arc-melting. The reaction of UF_6 with a bed of silicon and carbon yields UF_4 as the principal product at 300 to 600°C and UF_3 at 600 to 1200°C. A moving bed reactor is proposed for the production of uranium monocarbide from UF_6 in a single operation. (auth)

26075 PREPARATION AND PROPERTIES OF A PYROCARBON COMPRESSED AT HIGH TEMPERATURE. Maire, J. (Societe le Carbone Lorraine, Paris); Gremion, R.; Moreau, M.; Rappeneau, J.; Yvars, M.; Fillatre, A. Carbon, 5: 575-82(Dec. 1967). (In French).

A method for the preparation of material similar to a perfect graphite crystal was developed by studying the influence of pressure, temperature, and extrusion time. Properties measured were apparent density (2.266), electrical resistivity (direction a: 40 μ Ω-cm, c: 0.40 Ω-cm), room temperature thermal conductivity (direction a: 20 w cm^{-1} °K^{-1}, c: 0.08 w cm^{-1} °K^{-1}), thermal expansion; magneto-resistance, Hall effect, and elasticity. (UK)

26076 PREPARATION OF UO_2–Nb AND UO_2–Ta CERMET FUEL BY METAL VAPOR DEPOSITION IN FLUIDIZED BED AND HOT PRESSING. Amato, I.; Ardizzone, L. (FIAT, Turin). Contract 002-63-9CODI. Rev. Int. Hautes Temp. Refract., 4: 199-204(July-Sept. 1967).

The concept of UO_2 fuel dispersed throughout a metallic matrix provides a number of distinct advantages over conventional fuel

elements and interests a large number of laboratories in light of future applications in nuclear fuel technology. Cermets UO_2–Nb and UO_2–Ta have been prepared as fuel for nuclear thermionic reactors. The best deposition results were obtained at a reduction temperature of 900 to 950°C with an RH factor between 75 and 100. The evaporation rate must be 0.8 to 1.0 g of metal per hour as long as 1 micron thickness of metal sheath is deposited, then is possible to increase the evaporation rate at values of 2 to 4 g of metal per hour. The coated spheroids, hot pressed at 1600°C and 500 kg/cm² for times in the range 5 to 15 minutes, gave cermets having high densities (90 to 95% of theoretical values). (auth)

26077 THE PREPARATION OF OXIDE MONOCRYSTALS MO_2. Harari, A.; Thery, J.; Collongues, M. R. (Faculte des Sciences, Paris). Rev. Int. Hautes Temp. Refract., 4: 207-9(July-Sept. 1967). (In French).

Monocrystals of the oxides of Ti, Zr, Hf, Ce, and Th were prepared by a method derived from the flux method. The evaporation method causes a supersaturation of the solution in oxides. This makes possible a more rapid crystal growth than in the classical method of slow cooling. The crystal $ThTi_2O_6$ was also prepared. (J.S.R.)

26078 CHARACTERISTICS OF SOLIDIFICATION IN THE CONTINUOUS CASTING OF URANIUM CARBIDE. Trouve, J.; Accary, A. (CEN, Saclay, France). Rev. Int. Hautes Temp. Refract., 4: 225-30(July-Sept. 1967). (In French).

The aspect of longitudinal and transverse cross sections of U monocarbide rods obtained by electron beam fusion and continuous casting was studied by the micrographic method. Several characteristics of the crystallization are shown, in particular the existence of a critical casting rate. The existence of this critical rate is due to the competition between crystals growing on germs on the rod surface and crystals formed in the liquid by homogeneous germination. It was noted that in crystals without any privileged growing direction the crystal size obtained has a minimum for a given casting rate. The existence of this minimum is explained by the combination of two antagonistic phenomena: the germination rate and the disappearance of the smaller germs into the larger ones. (tr-auth)

26079 PRESSURE SINTERING OF CERAMICS. Vasilos, T. (Avco Corp., Wilmington, Mass.); Spriggs, R. M. pp 95-132 of Progress in Ceramic Science. Volume 4. Burke, J. E. (ed.). New York, Pergamon Press, Inc., 1966.

A review is presented of hot pressing (pressure sintering), its objectives (microstructural control, enhanced densification, composite fabrication, and pressure bonding), and the factors affecting and controlling the process. Applications of the process are described. A bibliography of 88 references is included. (D.L.C.)

Properties Evaluations

Refer also to abstracts 25333, 27457, 27485, and 27488.

26080 (AECL-3082) LOCALISED ELECTRONIC CONDUCTION BEHAVIOUR OF ANODIC OXIDE FILMS ON ZIRCONIUM. Ramasubramanian, N. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1968. 34p. Dep. CFSTI. CAN $1.00.

The light sensitive and semiconducting properties of cuprous iodide are used in a new technique for studying the electronic conduction behavior of anodic oxide films on zirconium. This technique provides information both on the distribution and nature of the conduction sites and has several advantages over existing methods. Specimens biased to either positive or negative potentials can be investigated; the resolution (size of the deposits in the image) is better than or equal to that of the other methods; less damage is done to the sample during the testing and there is only a slight increase in the overvoltage for the reaction with increase in oxide thickness. The last property makes the cuprous iodide imaging technique essentially different from the other methods. The conduction sites were identified with impurity particles present in the starting material. Anodic oxidation results in a thin insulating (compensated intrinsic) oxide film on these particles and their conductivity is determined by the contact used. The results indicate the possibility that some of the conduction sites are n-type and therefore that electrolytic rectification is associated with these. (auth)

26081 (AERE-R-5707) NEUTRON DIFFRACTION STUDY OF U_4O_9 AT LOW TEMPERATURES. Taylor, R. I. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 6p. Dep. CFSTI. UK.

A single crystal of U_4O_9 was examined by neutron diffraction at 4.2 to 31°K. There is no evidence of any magnetic ordering, even though the arrangement of atoms on the uranium sublattice is the same as for the antiferromagnetic compound, UO_2. (auth)

26082 (ORNL-TM-2097) PREPARATION AND PREIRRADIATION DATA FOR THE PYROLYTIC-CARBON-COATED SOL-GEL UO_2 PARTICLES FOR THE ETR X-BASKET-2 IRRADIATION EXPERIMENT. Hewette II, D. M.; Coobs, J. H.; Beatty, R. L.; Olson, A. R.; Beutler, H.; Prados, J. W. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 71p. Dep. CFSTI.

An account is presented of the particle preparation, the results of the preirradiation evaluation, and a description of the irradiation capsule assembly for the X-basket-2 pyrolytic-carbon-coated fuel-particle irradiation experiment designated experiment ETR-ORNL 43-97. (auth)

26083 (USBM-RC-1327) ELECTRICAL RESISTIVITY OF HYPERSTOICHIOMETRIC COLUMBIUM CARBIDE MATERIALS AT ELEVATED TEMPERATURES. Period Covered: November 1, 1966–November 1, 1967. Paulson, D. L.; Asai, G. (Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center). Jan. 1968. Contract AT(11-1)-599. 31p. Dep. CFSTI.

Elevated temperature electrical-resistivity measurements were made on arc-melted, spin-cast, and hot-pressed niobium carbide-carbon (NbC–C) materials up to 1,700°C. The arc-melted spin-cast NbC–C materials displayed electrical resistivity values ranging from 37.55 micro ohm-centimeter at 20°C for material containing 14.1 weight percent carbon to 242.64 micro ohm-centimeter at 1,622°C for material containing 17.0 weight percent carbon. The hot-pressed NbC–C materials exhibited electrical resistivity values ranging from 35.20 micro ohm-centimeter at 23°C for material containing 12 weight percent carbon to 188.80 micro ohm-centimeter at 1,732°C for material containing 21.3 weight percent carbon. The extrapolated values that were derived for stoichiometric niobium carbide ranged from 31.1 micro ohm-centimeter at 20°C to 96.9 micro ohm-centimeter at 1,500°C. (auth)

26084 EMISSIVITY AND ELECTRICAL RESISTIVITY OF SOME REFRACTORY CARBIDES. Petrov, V. A.; Chekhovskoy, V. Ya.; Sheindlin, A. E. (Academy of Sciences, Moscow). pp 270-7 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

The total hemispherical emissivity, the spectral emissivity for the wavelength of 0.65 μ, and the electrical resistivity of zirconium, titanium, niobium, and tantalum carbides have been determined. The samples used were rods and tubes sufficiently long to be heated by the electric current passing through them. Experimental data have been obtained in the temperature interval from 1200 to 3300–3500°K. A comparison is given of the results obtained with those of other investigators. (auth)

26085 ELECTRICAL AND THERMAL PROPERTIES OF SOME ACTINIDE COMPOUNDS. Moser, J. B.; Kruger, O. L.; Handwerk, J. H. (Argonne National Lab., Ill.). Proc. Brit. Ceramic Soc., No. 10, 129-40(Mar. 1968).

The electrical properties of compounds formed between uranium and plutonium and some group (IV)A–(VI)A elements are compared and discussed. Emphasis is on cubic compounds of high melting points, such as the mono-carbides, -nitrides, -phosphides, and -sulfides, owing to their importance in nuclear technology. Properties considered include electrical and thermal conductivity, and the Seebeck coefficient. Figures of merit of these nuclear ceramics are evaluated and discussed. (auth) (UK)

26086 INTERNAL FRICTION IN BERYLLIUM CERMET. Ivanov, V. E.; Zelenskii, V. F.; Faifer, S. I.; Savchenko, V. I.; Maksimenko, V. I. pp 180-3 of Internal Friction in Metals and Alloys. Postnikov, V. S.; Tavadze, F. N.; Gordienko, L. K. (eds.). New York, Consultants Bureau, 1967.

Temperature dependence of internal friction, and of shear and Young's moduli of hot pressed Be–BeO cermets containing 0.3, 1.5, and 7 wt % of BeO were investigated. Hot pressing of Be–BeO compacts partly destroyed surface oxide films of the powder particles and distributed them along grain boundaries. These conditions favor formation of single polycrystalline structures with strong particle bonding. Partly because of this the temperature dependence internal friction curve, Q^{-1} (T) showed only one peak. (P.G.C.)

Structure and Phase Studies

Refer also to abstracts 25320, 25333, 25441, 26054, 26469, and 26470.

26087 ON THE PHASE DIAGRAM OF THE NIOBIUM–OXYGEN SYSTEM. Fromm, E.; Jehn, H. (Max-Planck-Institut

fuer Metallforschung, Stuttgart). J. Less-Common Metals, 15: 242-3(June 1968).

A kinetic model is described for use in interpretation of results obtained from investigations of Nb–O systems. It is noted that tentative p-t-c phase diagrams of the Nb–O system should be based on the assumption that the important components of the gas phase are Nb-, NbO-, and NbO_2-molecules, whereas the O pressures measured in steady-state experiments have nothing to do with the thermodynamic equilibrium. (J.R.D.)

26088 EVALUATION OF OXYGEN PARTITION IN A THREE-PHASE BETA-ZIRCONIUM-OXYGEN ALLOY. Rosa, C. J. (Univ. of Denver). J. Less-Common Metals, 15: 183-91(June 1968).

Based on a unidirectional volume diffusion model, a phenomenological theory is developed for evaluating the oxygen partitions during oxidation of β-zirconium. The calculated total oxygen uptakes for zirconium oxidized at 875, 1000 and 1050°C agree well with those obtained from experimental measurements. The results conform to a parabolic rate law: $\Delta m/A = k_p \sqrt{t}$. The parabolic rate constants, k_p, are expressed in terms of diffusion parameters for the oxide, α- and β-phases. (auth)

26089 GROWTH OF SINGLE CRYSTALS FROM NONSTOICHIOMETRIC MELTS. Schroeder, J. B.; Linares, R. C. (Perkin-Elmer Corp., Norwalk, Conn.). pp 195-216 of Progress in Ceramic Science. Volume 4. Burke, J. E. (ed.). New York, Pergamon Press, Inc., 1966.

Nonstoichiometric, or flux, melt techniques are being used to grow high-quality single crystals for physical measurements and electronic devices. The technique is described and the fundamental principles of flux growth are given. Some experimental results on congruently and incongruently melting materials are given. A bibliography of 155 references is presented on crystal-growing literature. (D.L.C.)

Radiation Effects

Refer also to abstracts 27484 and 27497.

26090 (BNL–10279) RADIATION SINTERING OF SILICA SAND: APPLICATION TO THE LUNAR SURFACE. Damask, A. C. (Brookhaven National Lab., Upton, N. Y. Queens Coll., New York). [1966]. Contract AT(30-2)-Gen-16. 8p. Dep. CFSTI.

Silica sand was packed in a capsule which in turn was packed in an Al can filled with fine Al powder. Irradiation was carried out in a reactor for 1 week to a fast neutron dose of 6×10^{17} nvt. After cooling, the Al powder was found to have sintered into a solid cylinder. The capsule had burst at the bottom with consequent loosening of the sand, but at the center, the sand was sintered. Assuming the above dose to be the threshold for sintering, a rough estimate of 60 days is made for an equivalent effect in the solar wind on the lunar surface. (D.L.C.)

26091 (BNWL–679) THE EFFECTS OF IRRADIATION ON BORON CARBIDE. (A LITERATURE REVIEW). Evans, T. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1968. Contract AT(45-1)-1830. 49p. Dep. CFSTI.

The literature review was made to assess the pertinence of the data for fast-reactor application. After a consideration of the individual results, a comparative summary of the irradiation test results is tabulated. Purity, stoichiometry, mechanical stability, swelling, sintering, helium release, temperature effects, etc., are discussed. 34 references. (D.L.C.)

26092 (CEA-R–3358) IRRADIATION D'OXYDE D'URANIUM EN GAINE RESISTANTE. EFFET DU JEU DIAMETRAL INITIAL SUR LE COMPORTEMENT GLOBAL. (PROGRAMME CC-7: 1ere ET 2eme TRANCHES). (Irradiation of UO_2 in Strong Cans. Effect of Initial Diametral Clearance on Total Behavior. (CC-7 Program: Sections 1 and 2)). Janvier, Jean-Claude; de Bernardy de Sigoyer, Bruno; Delmas, Roger (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Oct. 1967. 78p. (In French). Dep.

Sixteen fuel elements made of thick Zircaloy tubes containing sintered UO_2, were irradiated to burnups of either 3000 or 6000 MWd/t. The specific power was continuously measured for each element. The initial diametral clearance was either 0.31 mm (free thermal expansion) or 0.12 mm (thermal expansion stress). The examinations of irradiated fuel elements suggest that: when the initial gap is high, the fuel expands until it comes in close contact to the sheath; the thermal resistance between fuel and sheath is higher than in the case where the fuel is stressed. A central hole and lenticular voids in movement toward the center by evaporation. Condensation can be seen only in specimens having the highest initial gap. Some fission products are concentrated at a certain distance from the center, corresponding to bright annuli on β autoradiography pictures; that event occurs only in large gap specimens. Fission gas release does not seem to be influenced by mechanical stresses applied to the fuel; the fraction released is coherent, in every case, with the probable temperature distribution. (auth)

26093 (ORNL–4229, pp 125-41) IRRADIATION BEHAVIOR OF HIGH-TEMPERATURE FUEL MATERIALS. Sisman, O.; Morgan, J. G. (Oak Ridge National Lab., Tenn.).

Research progress is reported on irradiation behavior of high-temperature fuel materials. Topics covered include: in-pile tests on pyrolytic-carbon-coated fuel particles, in-pile tests on silicon carbide-coated fuel particles, fission product release by post-irradiation annealing of coated particles, mechanisms of fission gas release from fueled pyrocarbon-coated microspheres, release of iodine from broken coated particles, post-irradiation studies of high-burnup coated particles, radiation damage in fast gas-cooled reactor fuels, fission-gas release during fissioning of UO_2, and in-pile thermal conductivity of UO_2. (M.C.G.)

26094 (ORNL–4229, pp 142-5) BEHAVIOR OF NONFISSILE MATERIALS UNDER IRRADIATION. (Oak Ridge National Lab., Tenn.).

Research is reported on the behavior of nonfissile materials under irradiation. Topics covered include: effects of large doses of fast neutrons on the monocarbides of Ti, Zr, Ta, Nb, and W; irradiation damage to refractory metal nitrides exposed to fast neutron doses from 0.7 to 4.9×10^{21} n/cm² at 150°C; irradiation damage to refractory metal disilicides exposed to fast-neutron doses from 0.4 to 2.7×10^{21} n/cm² at 150°C; and fast-neutron effects on electric insulators. (M.C.G.)

26095 RADIATION EFFECTS IN QUARTZ, SILICA, AND GLASSES. Lell, Eberhard; Kreidl, Norbert J.; Hensler, J. Raymond. pp 1-93 of Progress in Ceramic Science. Volume 4. Burke, J. E. (ed.). New York, Pergamon Press, Inc., 1966.

A review is presented of radiation processes and their relationship to defect structure in quartz, silica, and complex glasses. Structural and mechanical effects of neutron irradiation are considered, and the formation of color centers is discussed. Radio-induced absorption bands and spin resonance signals are tabulated. A bibliography of 290 references is included. (D.L.C.)

26096 STUDIES ON ETCHING OF NEUTRON-IRRADIATED CALCIUM FLUORIDE SINGLE CRYSTALS. Patel, A. R.; Desai, C. C. (Sardar Patel Univ., Vallabh Vidyanagar, India). Z. Kristallog., 126: 199-209(Jan. 1968).

Good quality natural crystals of calcium fluoride were cleaved, and a number of matched pairs were obtained. One piece from each pair was irradiated with different doses of neutrons in the swimming-pool Aspara Reactor. After irradiation, the irradiated and their non-irradiated counterparts were matched. They were then etched simultaneously in 0.28N perchloric acid for the same period. The etch patterns produced were studied optically. They were successively etched for three different periods, and the sizes and the depths of the pits on the nonirradiated and irradiated cleavages were measured. It is observed that (i) the irradiated cleavages etch at a faster rate than non-irradiated cleavages and, (ii) the rate of etching increases with increase in the dose of irradiation. A crystal plate 3.86 mm thick, irradiated with a dose of 1.3×10^{19} n/cm², was selected and cleaved into five thinner plates. All of them were etched simultaneously for the same period and the etch rate measured on them. The etch rates of the crystal faces were observed to increase with increase in the distance from the outer surface. The implications are discussed. (auth)

Plastics and Other Materials

Refer also to abstracts 27414 and 27494.

26097 (CONF-660706) USES OF PLASTICS IN THE PACIFIC NORTHWEST. Third Washington State University, Pacific Northwest, Plastics Workshop Meeting, July 14–16, 1966, Richland, Wash. (Washington State Univ., Pullman). 199p.

Thirty-two papers presented at the conference are included under the following headings: uses in agriculture; uses in wood; uses under radiation; market study of uses as foam; uses in reinforced structures; equipment, processes, and applications; and irradiated wood–plastics combinations. Separate abstracts were prepared for 5 of the papers. (M.C.G.)

For abstracts of individual papers see: 25371, 25570, 26037, 26098, and 26099.

26098 (CONF-660706–, pp 55-61) EFFECTS OF RADIATION ON PLASTICS. Gordon, N. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Radiation effects on the polymerization, crosslinking, and degradation of plastics are considered. Uses of plastics in a radiation environment and uses of radiation in processing plastics are discussed. (M.C.G.)

26099 (CONF-660706–, pp 111-23) A SURVEY OF THE USE OF PLASTICS AT HANFORD. Kleinpeter, J. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Many products and waste by-products are handled and stored wrapped in plastic film. Most of the film used is either vinyl chloride–vinyl acetate copolymer or polyethylene. The use of plastics as gaskets between pipe flanges is considered. Uses in glove boxes and hoods are also described. Perforated plates in the extraction columns in the fuel reprocessing facility are of plastic. Another use for plastic sheet material is as wall and floor covering. The effects of ionizing radiation on plastics are reviewed. (M.C.G.)

26100 (UCRL–17911) APPLICATION OF FRACTURE MECHANICS TO GLASSY PLASTICS. Key, P. L.; Katz, Y.; Parker, E. R. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1968. Contract W-7405-eng-48. 76p. Dep. CFSTI.

The use of linear elastic fracture mechanics to evaluate the effects of cracks in glassy plastics is reviewed. Plane strain fracture toughness values are obtained for polystyrene, polycarbonate, acrylic and a vinyl chloride-vinyl acetate copolymer. A strong dependence of fracture toughness on temperature and on strain rate at high strain rates is observed for polycarbonate and acrylic tested in the range of 123 to 348°K and 10^{-3} to 5 cm/min. Adequate agreement is observed among fracture toughness values obtained using single edge notch specimens, notched round specimens, and center notch specimens thus confirming currently recommended specimen designs for fracture toughness determination. (auth)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstracts 26090, 26305, 26320, and 26429.

26101 CORRECTION OF OBSERVATIONAL PROFILES OF SPECTRAL LINES. Smith, M. G.; Walker, A. N. (Univ. of Manchester, Eng.). Astrophys. Space Sci., 1: 151-65(Mar. 1968).

The profiles obtained from radial-velocity observations of the Rosette Nebula with a Fabry–Pérot interferometer (Meaburn and Smith, 1968) had to be corrected for the spreading action of the instrumental function, and for motion of the observer. Two current methods are compared and a method devised for fitting a sum of Gaussians to a noisy output profile. (auth)

26102 DYNAMICAL TIDES IN CLOSE BINARY SYSTEMS. I. Kopal, Zdenek (Boeing Scientific Research Labs., Seattle. Univ. of Manchester, Eng.). Astrophys. Space Sci., 1: 179-215(Mar. 1968).

The aim of the present paper is to develop from the fundamental equations of hydrodynamics a theory of dynamical tides in close binary systems, the components of which are regarded to consist of heterogeneous viscous fluid, and to revolve around their common center of gravity in eccentric orbits; moreover, the equatorial planes of their axial rotation and the orbital plane need not be co-planar, but all may be inclined to the invariable plane of the system of arbitrary amounts. The changes in the pressure or density invoked by time-dependent deformation are regarded as adiabatic; but, in the equilibrium state, both the density and viscosity of the material of the components may be arbitrary functions of the radial distance. Following a brief exposition of the fundamental equations linearized to small oscillations, be these free or forced, they are then particularized to describe spheroidal deformations, with due regard to all terms arising from viscosity. Section 4 contains a specification of the boundary conditions to be imposed upon such oscillations; and in Section 5 the problem of nonradial oscillations of self-gravitating inviscid configurations is solved in terms of hypergeometric series. The remaining Sections 6–8 are devoted to a discussion of the phenomena arising from viscosity: in particular, the problem of nonradial oscillations of incompressible viscous globes is solved in a closed form in the terms of Bessel functions. It is shown that the effects of viscosity, like those of compressibility, tend to destabilize all nonradial oscillations of homogeneous configurations. (auth)

26103 EVOLUTION OF CLOSE BINARIES OF SHORTER PERIOD AND MODERATE MASS. Plavec, M. (Astronomical Inst., Ondrejov, Czechoslovakia). Astrophys. Space Sci., 1: 239-63(Mar. 1968).

Evolution of close binaries was investigated for the case in which the more massive component has a mass of 5 $M_\odot$ and reaches the Roche limit when hydrogen is burning in its convective core. It is shown that a large-scale mass transfer occurs, during which the initial primary develops into a contact subgiant or giant, and the mass ratio is reversed or more than reversed. Although the process and its outcome depend on the initial conditions, in particular on the degree of chemical inhomogeneity in the interior of the primary component, the picture of evolution is essentially the same. Quantitatively the following phases can be distinguished and described: (1) premain-sequence contraction, when the less massive component is an undersize subgiant; (2) both components are on the main sequence; (3) rapid mass exchange, when the roles of the components are interchanged; and (4) slow mass transfer, when the system is semi-detached; this phase is typical for the Algol-like binaries. Further evolution depends on the rate of evolution of the components: either another phase with an undersize subgiant or a complicated system in which both stars lose mass prevails. Probabilities of discovery are calculated for the various phases of evolution. The paper is based on the calculations of stellar models with decreasing mass by means of Henyey's method. (auth)

26104 FILTER AND INTERFEROMETER OBSERVATIONS OF TWO H II REGIONS. Meaburn, J. (Univ. of Manchester, Eng.). Astrophys. Space Sci., 1: 230-8(Mar. 1968).

The Rosette Nebula was photographed through filters isolating the Hα, O(II), and O(III) nebular emission lines. Isophotes were constructed at these wavelengths. Measurements of the radial velocity differences across the Rosette were obtained from an interferogram. These were compared to some conflicting measurements made by previous authors. Some small regions in the Rosette and Barnard's Arc were shown to be emitting lines wider than the bulk of the matter. (auth)

26105 HYDROGEN FLICKER AND ASSOCIATED HIGH-ENERGY RADIATION. Hayakawa, Satio; Sugimoto, Daiichiro (Nagoya Univ., Japan). Astrophys. Space Sci., 1: 216-29(Mar. 1968).

The accretion of matter onto stars formed by carbon–oxygen cores triggers hydrogen flicker. The development of hydrogen flicker and the shock generation associated therewith are discussed. If the matter thus ejected is halted by a dense gas surrounding a star, a corona of high temperature is formed. This may take place in dense planetary nebulae and is regarded as an origin of starlike x-ray sources. More violent hydrogen flicker takes place at white dwarfs and may be an origin of novae. Nuclear-reaction products ejected are positron sources and they may provide MeV positrons as strong as 10^{-3} cm^{-2} sec^{-1} sr^{-1}. Nuclides produced by hydrogen flicker and a part of the carbon–oxygen core ejected may contribute to galactic cosmic rays; their chemical composition is like that observed in cosmic rays. (auth)

26106 OH EMISSION REGIONS AND EXTRATERRESTRIAL INTELLIGENCE. Sagan, Carl (Havard Univ., Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.). Astrophys. Space Sci., 1: 273(Mar. 1968).

Barrett (Science 157: 881(1967)) tentatively broached the possibility that the galactic 18-cm OH emission might actually be part of a communications network among extraterrestrial civilizations. It is pointed out that most OH regions have been found to be associated with large H(II) regions—the result of ionization of the interstellar gas by O and B stars. Such stars have main-sequence lifetimes of $\leq 10^8$ years which would seem too short for the origin of life and the evolution of technical civilizations substantially in advance of our own. (W.D.M.)

26107 PHOTOMETRIC AND SPECTROPHOTOMETRIC OBSERVATIONS OF NOVA DELPHINI 1967. Woszczyk, A.; Smolinski, J.; Maron, N.; Strobel, A.; Krempec, J. (Copernicus Univ., Torun, Poland. Astrophysics Lab., Torun, Poland). Astrophys. Space Sci., 1: 264-72(Mar. 1968).

Photographic, photovisual, and photoelectric (V) observations of Nova Delphini 1967 were made from August 8 to October 31. Simultaneously spectrophotometric measurements of the continuum were made on objective prism exposures extending to November 26, and spectrophotometric gradients derived. The continuum of Nova near its flat maximum is close to that of an early-type star in contrast to late-type absorption-line spectrum. (auth)

26108 POSSIBLE TEST OF THE STATIONARY CHARACTER OF THE UNIVERSE. Kalinkov, M. (Section of Astronomy, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1241-4(1967).

It is concluded that if discretization is assumed to exist, the stationary model is a convenient approximation for the local Universe (10^8 to 10^9 ps). (W.D.M.)

26109 MINERALOGY AND GENESIS OF THE CARBONACEOUS METEORITES. Kerridge, J. F. (Birkbeck Coll., London). pp 35-47 of Mantles of the Earth and Terrestrial Planets. Runcorn, S. K. (ed.). New York, Interscience Publishers, 1967.

From Mantles of the Earth and Terrestrial Planets Meeting, Newcastle-upon-Tyne, Eng. See CONF-660331.

The chemical, physical, and crystallographic data currently available on minerals present in carbonaceous meteorites are summarized. The broad features of an evolutionary path consistent with these data are then presented briefly. (A.G.W.)

26110 *ABUNDANCE OF THE ELEMENTS WITH SPECIAL* REFERENCE TO THE PROBLEM OF THE IRON ABUNDANCE. Urey, Harold C. (Univ. of California, San Diego). Quart. J. Roy. Astron. Soc., 8: 23-47(1966). (UCSD-34P43-8).

Work on elemental abundances in meteorites is briefly reviewed and the Suess–Urey method of compiling abundance tables is discussed. Other topics considered include recent astronomical studies on solar abundances, meteoritic abundances, the equilibrium peak, and the variable densities of the Earth, Moon, and planets. (W.D.M.)

26111 MODEL ATMOSPHERES FOR O5 V AND B0 V STARS WITH LINE BLANKETING. Hickok, Frederick R.; Morton, Donald C. (Princeton Univ., N. J.). Astrophys. J., 152: 203-10(Apr. 1968).

Two model atmospheres in radiative equilibrium were computed for log g = 4.0, T_e = 37450°K (θ_e = 0.1346) and T_e = 28640°K (θ_e = 0.176) incorporating the detailed blanketing of the strongest lines in the ultraviolet (911.6 ≤ λ ≤ 1700 Å), where the majority of the

flux emerges. The visible spectra closely resemble those of unblanketed models with log g = 4.0, T_e = 38180°K (θ_e = 0.132) and T_e = 30360°K (θ_e = 0.166), respectively. The corresponding models are classified as O5 and B0 V on the basis of the Balmer discontinuities. The bolometric corrections are estimated to be −3.23 and −2.57 for the blanketed models compared with −3.31 and −2.82 for the unblanketed ones. The strongest ultraviolet lines and details of the models are tabulated while the emergent flux distributions are shown graphically for λ > 911.6 Å and tabulated for shorter wavelengths. (auth)

26112 CONTRIBUTION TO THE PROBLEM OF SINGULARITIES IN GENERAL RELATIVITY. Pachner, J. (Astronomical Inst. of Czechoslovak Academy of Sciences, Prague). Bull. Astron. Inst. Czech., 19: 94-7(1968).

The present investigation is restricted to pressure-free, but arbitrarily distributed matter. The Einstein field equations are defined as having a singularity if the mass density determined by them becomes singular. First, an analytical proof of an unavoidable occurrence of singularities during a finite time interval is given for an irrotational motion of matter. Further, it is shown that the rotation cannot prevent the occurrence of singularities along the axis of rotation. The shear merely influences the occurrence of a gravitational collapse into the axis of rotation. (auth)

26113 MORPHOLOGICAL STUDY OF PLANETARY NEBULAE. III. UNCLASSIFIED AND PECULIAR OBJECTS. Hromov, G. S. (Sternberg State Astronomical Inst., Moscow); Kohoutek, L. Bull. Astron. Inst. Czech., 19: 90-94(1968).

There are, in principle, two groups of odd nebulae: objects for which classification is very doubtful owing to the unsuitability of the accessible observational material and objects which from the morphological point of view do not belong to the class of planetary nebulae. Further, the question on "double-shell" planetaries of Type 2d and 3d is discussed. The overwhelming majority of them could be interpreted by the projection of their peripheral structures. Nevertheless there are some real "double-shell" nebulae, the number of which probably does not exceed 2% of the known planetary nebulae, and which could perhaps originate due to recurrent outflow of the stellar material. Certain nebulae with morphological peculiarities were studied, namely, NGC 6543 and a group of nebulae NGC 40, 1501, 6751, and 6905. (auth)

26114 MORPHOLOGICAL STUDY OF PLANETARY NEBULAE. II. SPATIAL STRUCTURE OF PLANETARY NEBULAE. Hromov, G. S. (Sternberg State Astronomical Inst., Moscow); Kohoutek, L. Bull. Astron. Inst. Czech., 19: 81-90(1968).

The results of the classification of observed forms of planetary nebulae were applied to the problem of the spatial structure of these objects. A common spatial model of planetary nebulae is suggested. The main structure of the planetary nebula may be approximated as a right-angled toroid with the mean parameters: ΔL/L = 0.24, H/L = 0.65. In the first approximation the space orientation of the axes of the main structures has a random character. In principle, the peripheral structures show two different models; their mean geometrical parameters are given. The dynamical consequences following from the morphological picture are described. The conclusion is drawn that the expansion velocity field in planetary nebulae is axially symmetrical; the value of the expansion velocity in the equatorial plane of the main structure should be at least 1.5 to 2 times less than that in the polar regions. A qualitative scheme of the formation of observed toroidal structures of planetary nebulae is proposed. The dynamical role of the evolutionary process of ionization of planetary nebulae is emphasized. (auth)

26115 *THE OUTBURST OF NOVA DELPHINI 1967. II.* PHOTOELECTRIC OBSERVATION AT ONDREJOV IN 1967. Grygar, J.; Kohoutek, L.; Harmanec, P. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Prague). Bull. Astron. Inst. Czech., 19: 101-3(1968).

UBV observations for Nova Delphini (1967) are summarized and magnitudes for comparison stars are given. (W.D.M.)

26116 THE OUTBURST OF NOVA DELPHINI 1967. I. PHOTOELECTRIC OBSERVATION IN BRNO IN 1967. Onderlicka, B.; Vetesnik, M. (Purknye Univ., Brno). Bull. Astron. Inst. Czech., 19: 99-101(1968).

Nova Delphini (1967) was observed photoelectrically with the 60-cm reflector from Aug. 14, 1967 onwards. In addition to the B and V colors, observations were made in U and R. Results of the observations are tabulated. (W.D.M.)

26117 FLUX DENSITIES OF RADIO SOURCES AT 9.55-MM WAVELENGTH. Hobbs, R. W.; Corbett, H. H.; Santini, N. J. (Hulburt Center for Space Research, Washington, D. C.). Astrophys. J., 152: 43-9(Apr. 1968).

The flux densities relative to Jupiter of the following radio sources were measured at 9.55 mm using the 85-foot reflector of the Naval Research Laboratory: 3C 84, NRAO 150, Taurus A, Orion A, 3C 273, Virgo A, 3C 279, 3C 400, Cygnus A, 3C 454.3, and Cassiopeia A. (auth)

26118 ELECTRON SCATTERING AND TESTS OF COSMOLOGICAL MODELS. Bahcall, John N.; May, Robert M. (California Inst. of Tech., Pasadena). Astrophys. J., 152: 37-42(Apr. 1968).

The effect of photon scattering by electrons on the magnitude–red shift, count–magnitude, and number–red shift relationships in Friedmann cosmologies is discussed. (auth)

26119 THE COSMIC BLACK-BODY RADIATION AND THE EXISTENCE OF SINGULARITIES IN OUR UNIVERSE. Hawking, S. W.; Ellis, G. F. R. (Cambridge Univ., Eng.). Astrophys. J., 152: 25-36(Apr. 1968).

A recent theorem on the occurrence of space–time singularities is discussed. It is shown that observations of 3°K black-body background radiation indicate that the Universe contains a singularity if the general theory of relativity holds, if the energy–momentum tensor obeys a reasonable inequality, and if causality is not violated. The possible nature of the singularity is discussed. (auth)

26120 SCALAR–TENSOR GRAVITATION AND THE COSMIC FIREBALL. Dicke, R. H. (Palmer Physical Lab., Princeton, N. J.). Astrophys. J., 152: 1-24(Apr. 1968).

It has been shown that under conventional general relativity the cosmic fireball should convert 26 to 28% of the hydrogen to helium. Departure from an ideal isotropic and uniform universe should only increase the amount of helium formation. The contribution from the scalar field energy of the scalar–tensor type of gravitation theory can lead to the fireball's expanding so rapidly that virtually no helium is formed. If the present mass density of the Universe is in excess of 2×10^{-28} g cm^{-3}, corresponding to a closed space, zero helium production would be expected under the scalar–tensor theory. Thus a determination of the helium content of Population-II stars could provide a test for both theories of gravitation. (auth)

26121 WOLF-RAYET STARS. III. THE ECLIPSING SYSTEM V444 CYGNI. Kuhi, Leonard V. (Univ. of California, Berkeley). Astrophys. J., 152: 89-108(Apr. 1968).

Photoelectric spectrum-scanner observations of the emission-line and continuum intensities have been obtained for the Wolf–Rayet star V444 Cygni as a function of phase, with special concentration around secondary minimum so that the atmospheric stratification could be determined. Individual emission lines show greatly different eclipse curves decreasing in intensity at both secondary and primary minima. Secondary eclipse depths range from ~8% for He II λ4686 to ~30% for N v λ4609 at secondary minimum and from ~25% to ~50% for the same lines at primary minimum. Interpretation of these eclipse data in terms of purely geometric effects proved to be impossible. The most likely reasons for this failure appear to arise from the following: (1) increased excitation by the O star of the side of the W–R envelope facing the O star and resulting asymmetrical light distribution; (2) optical thickness of the W–R envelope to many of the emission lines; (3) enlargement of effective size of the emitting region by electron scattering; and (4) completely individualistic behavior of emission lines without regard to ionization or excitation potential so that extremely selective excitation processes must be operative. Therefore no definite conclusion can be reached concerning the stratification structure. The depth of secondary eclipse in continuum wavelengths increases with increasing wavelength and leads to a verification of the infrared excesses observed earlier in single W–R stars. It also implies that the presence of a hot star is not a necessary condition for the production of a W–R star, but does not rule out a much cooler companion for observed "single" W–R stars. The erratic fluctuations of both line and continuum intensities (as much as 0.1-mag increase in a 6-hour period) point to a random process of ejection, perhaps some type of large-scale prominence activity. Simple models such as uniform radial expansion are clearly ruled out. (auth)

26122 THE INTERMEDIATE-AGE CLUSTER NGC 2360. Eggen, O. J. (Australian National Univ., Canberra). Astrophys. J., 152: 83-7(Apr. 1968).

Three-color, photoelectric observations of NGC 2360 indicate that it has (a) a corrected distance modulus of 10.3 mag, E(B − V) = +0.07 mag, and δ(U − B) = 0.05 mag; (b) an age intermediate between that of the Hyades and NGC 752; (c) a small Hertzsprung gap; (d) a 0.2-mag gap at M_v = +2.9 in the sequence of evolved stars near the breakaway from the main sequence; and (e) at least two blue stragglers. The (M_v,C) diagrams of M67, NGC 752, and NGC 2360 are compared. (auth)

26123 PHOTOMETRIC EVIDENCE FOR THE EXISTENCE OF A DELTA LYRAE CLUSTER. Eggen, O. J. (Australian National Univ., Canberra). Astrophys. J., 152: 77-81(Apr. 1968).

Photoelectric (UBV) photometry of 77 stars to visual magnitude 17.5 in the region of δ Lyrae reveals the presence of the cluster previously suspected by Grant and Stephenson. Values of $E(B-V) = +0.05$ and $(m-M)_0 = 7.5$ mag are derived. The cluster is similar in age, in distribution of stars on the main sequence, and in motion to other members of the Pleiades group. The brightest star, δ^2 Lyr (M4 II), has a luminosity of $M_v = -3.3$ mag. (auth)

26124 SCATTERING PROPERTIES OF INTERSTELLAR PARTICLES. I. DIFFUSE GALACTIC RADIATION. Witt, Adolf N. Astrophys. J., 152: 59-76(Apr. 1968).

New photoelectric measurements in three band passes centered at λλ3600, 4350, and 6100 Å of the intensity and distribution of the diffuse radiation in the Galaxy in the constellations of Cygnus and Taurus–Auriga are presented. Contaminations originating in other sources of light in the night sky have been investigated and are taken into account. The residual intensity is interpreted as general galactic starlight scattered by interstellar dust particles. A model for the radiative transfer of direct and scattered starlight in the Galaxy is discussed, and parameters related to the distribution of stars and dust are derived. Scattering properties of the interstellar particles are determined by comparing the observations with model computations of the intensity of the diffuse galactic radiation for various values of the albedo and the asymmetry of the phase function of the particles. The result of this study is that interstellar scatterers have an albedo close to unity and an isotropic phase function over the observed wavelength range. The observations rule out particles consisting of dirty ice, pure graphite, or graphite covered with a shell of ice as long as their scattering properties are described by the classical Mie theory for spherical isotropic particles. Quantum mechanically scattering particles as suggested by Platt are expected to exhibit characteristics in agreement with the observations. (auth)

26125 A SEARCH FOR HYDROGEN IN THE SOUTHERN COALSACK. Kerr, F. J. (Univ. of Maryland, College Park); Garzoli, Silvia. Astrophys. J., 152: 51-8(Apr. 1968).

A new attempt to find neutral hydrogen in the southern Coalsack from 21-cm observations was unsuccessful. Background fluctuations are large in this region, but the hydrogen would be easily observable for normal values of the gas-to-dust ratio and the excitation temperature. (auth)

26126 THERMODYNAMIC FUNCTIONS OF AN IONIZING ATOMIC PLASMA. Fischel, David (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 152: 353-4(Apr. 1968).

A general method is presented for the derivation of the thermodynamic functions of a plasma of arbitrary chemical composition in the case that molecules and negative ions may be neglected. This method is applied to evaluate c_p, ∇_{ad}, and Q. (auth)

26127 THE SUPPORT OF THE ENVELOPES OF Be STARS. Limber, D. N.; Marlborough, J. M. (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 152: 181-93(Apr. 1968).

The nature of the support of the envelopes of Be stars is explored. The different forces that appear to deserve consideration are examined systematically and the importance of each in accounting for the observed support is estimated. Independent observational evidence concerning the dependence of the circular velocity for one of these envelopes upon distance from the parent star's rotation axis is also examined, as are two arguments of a more general nature that bear upon the problem. It is concluded that the support of an envelope of this kind is centrifugal and that the viscous agent that is necessary to provide the required transfer of angular momentum from the star to the envelope is one that results either from magnetic fields that couple the two or from the turbulence that is expected to develop in such a differentially rotating envelope. It is shown that turbulence can play a major role only if the turbulence is moderately supersonic; whether such turbulence can develop and is consistent with the observations is not yet clear. Magnetic field remains a prime candidate for the required viscous agent even though the case for its importance is largely circumstantial. (auth)

26128 A MODEL ATMOSPHERE FOR A B4 V STAR WITH LINE BLANKETING. Adams, Thomas F.; Morton, Donald C. (Princeton Univ., N. J.). Astrophys. J., 152: 195-202(Apr. 1968).

A model in radiative equilibrium was computed for $\log g = 4.0$, $T_e = 16800°K$ ($\theta_e = 0.300$) taking into account the detailed blanketing of the strongest lines in the ultraviolet ($911.6 \leq \lambda \leq 1600$ Å), where the majority of the flux emerges. It was found that the visible spectrum closely resembles that of an unblanketed model with $\log g = 4.0$, $T_e = 17680°K$ ($\theta_e = 0.285$). Both models were classified as B4 V on the basis of the Balmer discontinuity. Thus at this spectral type the effective temperature assigned using an unblanketed model was too high by 885°K. The bolometric correction was estimated to be −1.34 for the blanketed model compared with −1.56 for the unblanketed one. Details of the model are given in tabular form and the emergent flux distribution is shown graphically. The model was compared with stellar observations at 1115, 1314, 1376, and 1427 Å. Reasonable agreement was found at 1314 and 1376 Å, but the observed fluxes are significantly less than the predictions at 1115 and 1427 Å. (auth)

26129 THEORETICAL LINE INTENSITIES. VI. MILNE–EDDINGTON CURVES OF GROWTH FOR NON-COHERENT SCATTERING. Athay, R. Grant; Skumanich, A. (High Altitude Observatory, Boulder, Colo.). Astrophys. J., 152: 211-16 (Apr. 1968).

Curves of growth were derived for different mixtures of noncoherent scattering and pure absorption and compared with similar curves computed by Wrubel for mixtures of coherent scattering and pure absorption. The curves including fractional noncoherent scattering tend to mimic the pure coherent scattering curves on the linear portion of the curve of growth but tend to bridge over to the pure absorption curves for very strong lines. (auth)

26130 INVERSION OF THE LIMB-DARKENING EQUATION USING THE PRONY ALGORITHM. White, O. R. (Univ. of Hawaii, Honolulu). Astrophys. J., 152: 217-23(Apr. 1968).

King's interesting application of the Prony algorithm to the inversion of the limb-darkening equation is modified and generalized so that it can be applied rigorously to limb-darkening curves, spectral line profiles, and multiplet line intensities. Since King's formulation requires physically inaccessible observations, a change of variable is introduced in the limb-darkening integral to avoid this difficulty. Calculations on noisy data confirm the self-limiting property of this inversion method. An approximate method for constructing the smooth $S(\tau)$ distribution from the slab solution is presented. (auth)

26131 POSSIBLE EXPLANATION OF THE 300-SECOND TYPE OSCILLATION IN THE SOLAR CHROMOSPHERE. Ulmschneider, P. H. (Univ., Tuebingen, Ger. (Univ., Wurzburg, Ger.). Astrophys. J., 152: 349-50(Apr. 1968).

If attention is restricted to heights larger than 1000 km above $\tau_{5000} = 1$, there is the possibility that the oscillations of the 300-sec type in the solar atmosphere discovered by Leighton (1960) may be explained by the Väisälä (1925) mechanism. Points in favor of the Väisälä mechanism are enumerated. (W.D.M.)

26132 EVOLUTION OF MASSIVE HELIUM-BURNING SUPERGIANTS. Stothers, Richard; Chin, Chao-wen (Goddard Space Flight Center, New York). Astrophys. J., 152: 225-32(Apr. 1968).

Models were constructed for massive stars of 15, 60, and 100 $M_\odot$ in the core helium-burning phase of evolution. Their luminosity remains nearly constant during evolution and is relatively insensitive to uncertainties in the interior structure, whereas the effective temperature is definitely not. Previously published models in which the opacity was taken to be only electron scattering or in which the envelope instability was treated as fully convective start helium burning as blue supergiants. With the inclusion of bound-free absorption and semiconvective mixing, the models start as red supergiants, then move to the blue region. The effective temperature of blue supergiants may also be lowered by increasing the hydrogen, metals, and/or CNO abundances. The fraction of time spent in the blue region and the maximum effective temperature attained are probably both larger at higher masses. However, these are very sensitive to conditions in the previous red-supergiant phase. Subsequent to the blue phase, the stars are expected to burn carbon (in a second red-supergiant phase). It is suggested that the red supergiants in young clusters like h and χ Per may be, at least in part, in the core helium-burning phase of evolution. (auth)

26133 PULSATIONAL STABILITY OF BLUE SUPERGIANTS. Stothers, Richard (Goddard Space Flight Center, New York); Simon, Norman R. Astrophys. J., 152: 233-44(Apr. 1968).

The brightest blue supergiants represent the most massive evolved stars known. They are believed to be in the core helium-burning phase of evolution. To discuss the question of their stability, model interiors of core helium-burning stars with hydrogen-burning shells were constructed and tested for pulsational instability (15 to 1000 $M_\odot$). All models are found to be extremely stable against nuclear-energized pulsations despite the high radiation pressure. Consequently, any star with mass less than the critically stable mass on the main sequence should evolve into

the blue-supergiant region without disruption. By combining the theoretical calculations with the available observational data for the Large Magellanic Cloud, a self-consistent set of parameters may be obtained for the Large Cloud as follows: (1) the coincidence of the mass of the most luminous supergiants with the critical mass on the main sequence, (2) the occurrence of this mass at about 60 $M_\odot$, (3) a hydrogen abundance of X = 0.75 in the young Cloud population, and (4) a distance modulus of $(m - M)_0 = 18.7$. The remarkable observed constancy of brightness of the most luminous B supergiants and their stability against disruption or large amounts of mass loss are further verified theoretically. Any other kind of variability is likely to be due to atmospheric phenomena or to binary motion. The mass of the brightest Cepheids in the Magellanic Clouds is about 15 $M_\odot$. In our Galaxy, the most luminous supergiants known have inferred masses which do not significantly exceed the critical mass, nor is there any certain evidence for supermassiveness among the observed O stars. (auth)

26134 MODEL FOR THE NOVA OUTBURST. Rose, William K. (Princeton Univ., N. J.). Astrophys. J., 152: 245-53(Apr. 1968).

Models for a hydrogen-exhausted star that accretes small amounts of hydrogen-rich mass are computed. Hydrogen burning is shown to increase as the mass of the hydrogen-rich envelope is increased. Eventually the nondegenerate hydrogen-burning shell becomes thermally unstable. Pulsational instability is found to develop as a consequence of the thermal instability. The possible connection between the models studied and the occurrence of novae is discussed. (auth)

26135 NON-RADIAL OSCILLATIONS OF SLOWLY ROTATING POLYTROPES. Durney, B.; Skumanich, A. (High Altitude Observatory, Boulder, Colo.). Astrophys. J., 152: 255-66(Apr. 1968).

The linearized equations for nonradial adiabatic oscillations of slowly rotating polytropes were studied for both stable and marginally stable states. For oscillations in the stable state, the eigenfrequencies are a continuous function of the parameter $\gamma_1 = (\gamma - \Gamma)/(m\omega)^2$, which measures the ratio of buoyant to gyroscopic forces; here $\Gamma = 1 + 1/n$, where n is the polytropic index, γ is the ratio of the specific heats, ω the nondimensional angular velocity, and m determines the azimuthal dependence. The structures of these oscillations, which could be called gravitational gyroscopic waves, are determined from two coupled first-order partial differential equations. In the marginally stable state one finds the solutions to be oscillatory, thus indicating overstability; the parameter γ_1 takes on discrete negative values which indicate the stabilizing influence of rotation. (auth)

26136 PULSATIONS AND THE DYNAMICAL STABILITY OF GASEOUS MASSES IN UNIFORM ROTATION. Chandrasekhar, S.; Lebovitz, N. R. (Univ. of Chicago). Astrophys. J., 152: 267-91(Apr. 1968).

A variational principle, applicable to axisymmetric oscillations of uniformly rotating axisymmetric configurations, is established. On the assumption that the Lagrangian displacement (describing the oscillation) at any point is normal to the level surface (of constant total potential) through that point, it is shown how the variational expression, for the frequencies of oscillation, can be reduced to simple quadratures. The reduction is explicitly carried out for certain stratifications of special interest. Some new results on the oscillations of slowly rotating configurations are included; and a number of related observations on their stability are also made. (auth)

26137 VIRIAL EQUATIONS OF THE FOURTH ORDER. Chandrasekhar, S. (Univ. of Chicago). Astrophys. J., 152: 293-304(Apr. 1968).

The virial equations of the fourth order are derived; and the results of certain formal developments needed for their practical usefulness are also given. The equations are then used to locate the neutral points, along the Maclaurin and the Jacobian sequences, that belong to the fourth harmonics. (auth)

26138 X-RAY AND MICROWAVE EMISSION OF THE SUN WITH SPECIAL REFERENCE TO THE EVENTS OF JULY 1961. Acton, Loren W. (Lockheed Palo Alto Research Lab., Calif.). Astrophys. J., 152: 305-17(Apr. 1968).

X-ray ($\lambda < 14$ Å), microwave ($\lambda = 10.7$ cm), optical, and ionospheric observations are utilized together with theoretical x-ray spectra to derive physical models of some x-ray emitting volumes on the Sun. The following kinds of emitting regions are studied: (1) a large "permanent" coronal condensation; (2) a flare in its flash phase; (3) a yellow-line condensation associated with a post-flare loop-prominence system. Most of the observational data were gathered during the month of July, 1961. This period presented the opportunity to study the x-ray emission of the Sun over a wide range of solar activity and at the same time unambiguously to identify the sources of the emission. Both thermal and non-thermal emission processes seem to be required to account for the x-ray emission from flares. This study indicates that it is not necessary to invoke temperatures higher than 4 to 5×10^6°K to account for the thermal radiation of flares. The prolonged enhancements of soft x rays which follow some large flares appear to be thermal emission from the same "sporadic" coronal condensations which emit the yellow line of Ca XV. In the case of the yellow-line condensation studied here, the observations are best fitted if 1% of the volume contains 90% of the material. (auth)

26139 X-RAY EMISSION SPECTRUM OF A SOLAR ACTIVE REGION. Evans, K.; Pounds, K. A. (Univ. of Leicester, Eng.). Astrophys. J., 152: 319-35(Apr. 1968).

Absolute intensities are presented for twenty-eight identified and four unidentified solar x-ray emission lines between 11 and 22 Å measured during a Skylark rocket flight on May 5, 1966. It is found that the total line emission exceeds the x-ray continuum by at least a factor of 5, and this is shown to be consistent with an emission model derived from the observed line spectra. Excellent agreement is found between the total flux and a simultaneous observation obtained with a broad-band (8 to 20 Å) ion chamber of the NRL SOLRAD satellite series. Of the measured emission lines, those of O VII are distinct, both in their observed profiles and in consideration of the coronal temperatures at which they are efficiently produced. These lines are interpreted as arising principally from the general coronal disk at a temperature between 10^6 and 1.5×10^6°K. In contrast, all the other observed lines show a strong component clearly associated with a coronal active region, and the absolute line intensities are used here to derive a model of this region. Good agreement of the calculated and observed spectra of O VIII, neon, iron, and nickel is obtained with the bulk of the active region plasma at a temperature of 3×10^6°K. The corresponding value of $N_e^2V = 1.7 \times 10^{49}$ cm^{-3} is consistent both with the nonobservation of a solar continuum below 14 Å and with the separate values of N_e^2 and V obtained for similar active regions from recent broadband x-ray photographs. Element abundances for neon, iron, and nickel are determined relative to oxygen and are found to be in good general agreement with values obtained from analyses of solar ultraviolet spectra. (auth)

26140 CARBON CONTENT OF THE HELIUM STAR BD + 10°2179. Hunger, Kurt; Klinglesmith, Daniel A. (Goddard Inst. for Space Studies, Greenbelt, Md.). Astrophys. J., 152: 343(Apr. 1968).

The effective temperature of BD + 10°2179 was established from the ionization equilibria of the Si II/Si III and S II/S III lines: $T_{eff} = 18{,}000°$, the gravity from the profiles of the He I lines: $\log g = 3.0$. Using this model, the abundance of carbon, derived from twenty C II lines, was found to be 0.3 (by mass fraction), or 0.1 (by number fraction), while the abundance of hydrogen derived from Hγ and Hδ, was $x = 3 \times 10^{-4}$. A turbulent velocity v_t, of 10 km/sec was assumed; with a smaller v_t, an even larger carbon abundance would result. (W.D.M.)

26141 LOW-MASS RED GIANTS: HELIUM OR NITROGEN FLASH. Eggleton, Peter P. (Univ. of York, Eng.). Astrophys. J., 152: 345-7(Apr. 1968).

A criterion is established for deciding whether nitrogen burning in degenerate helium stellar cores will occur before the helium flash. It is concluded that, if the zero-age fractional mass abundance of CNO material is substantially greater than about $1/_{300}$, this will happen. (auth)

26142 ZIRCONIUM ISOTOPE RATIOS IN THE S-TYPE STAR HR 1105. Schadee, Aert; Davis, Dorothy N. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 152: 169-79(Apr. 1968).

The spectrum of the bright non-variable star HR 1105 was studied at 3 Å/mm; it is S type with some features of type M. The wavelengths of isotopes of ZrO were computed and used to improve the molecular constants by comparison with laboratory measurements. Direct use of isotope shifts is not possible. The isotope ratios of zirconium in HR 1105 were estimated by fitting elaborately computed ZrO profiles to the observed spectrum in a limited, supposedly uncontaminated, region. Two sets of isotope ratios which best match the stellar spectrum were found: (a) a terrestrial mixture, but with a high abundance of unstable ^{93}Zr, i.e., $^{93}Zr/^{90}Zr \cong 1/_3$, and (b) the ratios $^{91}Zr/^{90}Zr$, $^{92}Zr/^{90}Zr$, and $^{94}Zr/^{90}Zr$ larger by a factor of 2 or 3 than the terrestrial ratios, with ^{93}Zr at low abundance. The present observations do not permit a choice between these two possible isotopic mixtures. An upper limit to ^{96}Zr is probably less than 10% of the Zr content. No trace of strong lines of $Zr^{17}O$ or $Zr^{18}O$ was found. Thus Zr isotopes produced by the s-process apparently differ, in this star,

from the terrestrial values, and the supposed production of ^{18}O has probably not occurred. (auth)

26143 COMPARISON OF SELECTED CARBON STARS AND M-STARS AT 1 MICRON. Fay, Theodore D. (Indiana Univ., Bloomington); Frederick, Laurence W.; Johnson, Hollis R. Astrophys. J., 152: 151-67(Apr. 1968).

Spectrograms in the 1-μ region of two carbon stars (W Ori and RY Dra) and two M stars (α Sco and R Hya) with a reciprocal dispersion of 46 Å/mm and a resolution of 1.5 Å are discussed and compared. Numerous certain atomic line identifications are possible in α Sco, several in R Hya, and only Mg I (37), Ca I (43), and Ti I (31) in the carbon stars. The difficulties of identifying atomic lines in carbon stars are discussed. Many additional probable identifications are tabulated. A supplementary list of atomic lines from heavy elements is given. Many coincidences with lines of CN and C_2 are noted, and the rotation lines of the Q-branch from J = 65 to J = 90 of the CN (1,0) vibration band are discussed in detail. A list of the principal unidentified features is provided. (auth)

26144 EMISSION CORES IN H- AND K-LINES. III. THE WILSON-BAPPU EFFECT. Athay, R. Grant; Skumanich, A. (High Altitude Observatory, Boulder, Colo.). Astrophys. J., 152: 141-50(Apr. 1968).

Widths of the emission components, W_2, of the H- and K-lines of Ca II were investigated, assuming that the lines are formed in optically thick chromospheres with temperature increasing outward. The line source function S was computed from an equation relating S to the Planck function and the divergence of the line flux. W_2 was found to be particularly sensitive to chromospheric opacity both in the line and in the continuum, to the damping parameter $\underline{a}$, and to the chromospheric Doppler width. The results were interpreted to mean that the Wilson-Bappu effect arises primarily from changes in Doppler width, and, further, that there is a tendency among the chromospheres of late-type stars to have approximately the same line and continuum opacities and to have $\underline{a} \leq 3 \times 10^{-3}$. To a first approximation, the intensity of the emission component was found to be uncorrelated with W_2. (auth)

26145 THE HELIUM LINE λ 10830 A IN LATE-TYPE STARS. Vaughan, Arthur H. Jr.; Zirin, Harold (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 152: 123-39(Apr. 1968).

Spectroscopic observations in the region λλ10660 to 10915 Å in eighty-six stars are presented. The observations consist primarily of image-tube spectrograms, with 8.4 Å/mm dispersion, taken with the coudé spectrograph of the 200-inch telescope. Additional measurements were obtained with a spectrum scanner and with a Fabry-Pérot interferometer in the coudé spectrograph of the 100-inch telescope. The λ10830 line of neutral helium appears in absorption in a substantial number of "normal" G and early K stars. In these stars there is a rough statistical tendency for λ10830 absorption to increase in strength with increasing Ca II K emission intensity. In contrast to the K line, there is also a correlation of λ10830 intensity with luminosity. The line is usually broader than normal photospheric lines, and violet shifts are common in highly luminous stars. The line λ10830 is probably not present, at least with appreciable strength, in either F or M stars. The line appears in emission (typically accompanied by a violet absorption edge) in ε Gem, 12 Peg, θ Her, γ Dra, and ι Aur. Temporal changes were observed in α Aqr and γ Dra. The presence of λ10830 in late-type stars indicates the existence of hot chromospheres. The data suggest that the line originates in discrete clouds or streams rather than a homogeneous layer. Line identifications and eye estimates of intensities in the range λλ10660 to 10915 Å for six stars of types F8-M0 are tabulated. (auth)

26146 PHOTOELECTRIC BALMER-LINE PHOTOMETRY. II. OBSERVATIONS OF HR 9080 AND RELATED SPECTRUM VARIABLES. Wood, H. John (Indiana Univ., Bloomington, Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 152: 117-22(Apr. 1968).

Photoelectric line-curve observations of HR 9080 show time variations of about 10% in the effective equivalent widths of Hβ, Hγ, and Hδ. Quasi periods of about 35 min are found. The oscillations become unrecognizable after several cycles. A similarity to the 5-min oscillations of the Sun is noted. A brief discussion of Balmer-line behavior in fourteen other stars is given. (auth)

26147 THE RAPIDLY ROTATING OLD DISK STAR HD 6870. Rodgers, A. W. (Australian National Univ., Canberra). Astrophys. J., 152: 109-16(Apr. 1968).

HD 6870, which Eggen suggests is a member of the old disk σ Pup group, was observed spectrophotometrically. Atmospheric parameters are $\theta_{eff} = 0.695$ and $\log g = 3.75$. The star rotates with $v_e \sin i = 130$ km/sec. The metal abundance is [Ca/H] = -0.84, consistent with group membership. The best derived mass, on the assumption of group membership, is $1.45 \pm 0.6\ M_\odot$. The star may be too massive to have evolved from the turnoff point of the group and could be an evolved close binary in which mass exchange has occurred. (auth)

26148 FREQUENCY SPECTRUM OF COSMIC RADIO EMISSION IN 10- TO 207-MHz RANGE AT HIGH GALACTIC LATITUDES. Getmantsev, G. G.; Karavanov, V. S.; Sazonov, Yu. A.; Tarasov, A. F. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 191-9(1968). (In Russian).

A description is given of antennas, apparatus, and methods of measurement of the frequency spectrum of 40 to 207 MHz. According to the measurements made, the average spectral index of the radio emission is $\alpha = 0.57 \pm 0.04$. Comparison with the results obtained by other authors shows that at the high galactic latitudes the spectral index of distributed cosmic radiation with the growth of frequency from 10 to 207 MHz varies comparatively little. (auth)

26149 SCINTILLATION OF DISCRETE SOURCES IN TROPOSPHERE. Dem'yanenko, L. N.; Stankevich, K. S.; Shipyalya, O. N. Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 200-4(1968). (In Russian).

Troposphere scintillations at setting and rising of the discrete sources Cygnus-A, Taurus-A, and Orion were observed at the wavelength λ = 30 cm during the year. The dependences of the index and velocity of scintillations on the zenith angle were obtained, as well as their seasonal variations. The height of the layer with irregularities, which appeared to be equal to 10 km for summer period and 3 km for the winter one, was established from the comparison of the scintillation index curve with the function $z(\sec \varphi)^{\frac{1}{2}}$. (auth)

26150 ABOUT SOME SOLUTIONS OF THE MULTIDIMENSIONAL THEORY OF GRAVITATION WHICH CAN FIND AN APPLICATION IN ASTRONOMY AND PHYSICS. Kalicin, Nikola St. Izv. Sekts. Astron., Bulg. Akad. Nauk, 1: 19-30(1967). (In Bulgarian).

Some important solutions of the generalized Einstein's gravitational equations were found, with the right side equal to zero for the five-dimensional, and seven-dimensional Riemannian spaces. In the five-dimensional Riemannian space the case with hyperspherical symmetry is examined. This symmetry greatly simplifies Einstein's equations, and gives a possibility of obtaining a strict solution, which is analogous to the important solution of Schwarzschild for the four-dimensional Riemannian space with an ordinary spherical symmetry. Moreover Riemann's tensor of the curvature does not vanish, i.e., the newly found strict solution represents a real gravitational field, and cannot be reduced to the trivial case of cartesian metrics. It is shown that the new solution can represent real gravitational waves, travelling with the velocity of light. These waves possess a spatial spherical symmetry, which proves that the famous theory of Birkhoff for nonexistence of spherically symmetrical gravitational waves in the general theory of relativity for the five-dimensional Riemannian space, is not valid. The new strict solution obtained can find a number of important applications in astronomy, such as an emission of gravitational waves from pulsating stars, etc. (Abstr. Bulg. Sci. Lit.)

26151 STATISTICAL VERIFICATION OF A HYPOTHESIS FOR QUASARS. Sadovski, Ljubomir-Aleksandar; Kalinkov, Marin. Izv. Sekts. Astron., Bulg. Akad. Nauk, 1: 65-76(1967).

A statistical verification of the hypothesis, that the variations in the luminescence of quasars are caused by explosions of supernovae, is made. A standard curve of the luminescence of the supernovae without a given luminance is taken as a base. The verification concerns 7 models with Poisson's distribution of the number of explosions in unit intervals of time (one solar day). For those models: N = 30, 10, 5, 3, 0.5, and 0.1 explosions during a solar day. After the construction of the verificational statistic graphs it becomes obvious that the models for which $0.5 < N < 1$ explosions during a solar day are in accordance with the data from the observations, and that this estimate is in accordance with other authors' results, obtained by completely different methods. The energy of the explosion of a supernova is estimated when the energy consumption of quasars is known (particularly for 3C 273). (Abstr. Bulg. Sci. Lit.)

26152 INVESTIGATION ON CLUSTERS AND GROUPS OF CLUSTERS OF GALAXIES. Kalinkov, Marin. Izv. Sekts. Astron., Bulg. Akad. Nauk, 1: 77-101(1967).

The structure of clusters, and groups of clusters of galaxies was investigated on the basis of materials from Lick's counting of the galaxies. The studied clusters and groups were cataloged (44 objects). The isolines (isoplets) were measured by a planimeter on the contour maps, and the corresponding areas, normed to 1, are

given in a table. The relative inhabitance of the clusters, and the groups of clusters of galaxies, are represented in figures. All the clusters studied are classified in four groups. (Abstr. Bulg. Sci. Lit.)

26153 THEORETICAL ASTROPHYSICS. Pecker, Jean-Claude. Sciences (Paris), No. 47: 129-44(Jan.-Feb. 1967). (In French).

A general introduction to some of the problems of theoretical astrophysics is given. The first problem of the astrophysicist is analysis of data, for example, spectra of stars. Discussion of multiple interpretations for certain types of data, including red-shifts, follows; the inclusion of superfluous parameters to explain supposed indeterminacies or overinterpreted data with optimistic error limits is noted, and the problem of determination of interdependence of parameters is touched on. Physical interpretation of data to yield temperature, stability, convection movements, turbulences, and atmosphere characteristics is discussed. The level for discontinuity of microturbulence in the Sun is noted as an example of the problems of interpretation. Finally, synthesis of these data into a general picture of the Universe must be made. A short history of the development of theoretical astrophysics in France is given up to the creation of the chair at the Collège de France. (BBB)

26154 X-RAY ASTROPHYSICS. De Jager, C. (Utrecht Univ.). Scientia (Milan), 102: 407-17(1967).

The origin, nature, and detection of extraterrestrial ionizing radiations are reviewed. Solar flares and x rays are also discussed. The history of discovery of x rays and nonstellar galactic sources is reviewed. About 30 nonsolar x-ray sources are now known. They are all concentrated near the galactic plane, indicating that the sources belong to the galactic system. The practical difficulty of determining the position of the sources is discussed. Also considered are the spectra and the identification of these sources. The small number of sources and inaccuracy of the measurements hamper final identification. There are perhaps 2 kinds of x-ray sources. To the first class belong objects like the Crab Nebula, where x radiation is emitted by a very energetic gas consisting of fast electrons moving in spiral-like orbits in a very strong magnetic field and emitting synchrotron radiation. The spectrum extends over a very large wavelength range and the flux is very strong. Another group of x-ray sources could be of stellar origin. The first indication in that direction might be the identification of the source Sco X-1. The x-ray spectrum is like that of a tenuous gas with a temperature of 60×10^6 °K. (BBB)

26155 EFFECTS OF MAGNETIC BOTTLE SYSTEMS FROM SOLAR FLARES. Gopasyuk, S.; Krivsky, L. (Astrophysical Observatory, Crimea, USSR.; Astronomical Inst., Ondrejov, Czechoslovakia). Bull. Astron. Inst. Czech., 18: 135-43(1967).

After analyzing cosmic radiation data recorded by neutron monitors at the Deep River Station and data on solar flares published at Zurich from 1959 to 1964, the authors concentrated on 51 Forbush effects related with magnetic bottles from flares which they plotted on diagrams of the solar disc. They found 8 cases in which Forbush effects appeared after flares which occurred in another active region, and established that in each case the new effect was markedly east of the region which produced the preceding effect, although in three exceptional cases the Forbush effects due to flares in the east limb followed shortly after occurrence of flares from the western half of the disc. One of the explanations given is that magnetic bottles may be connected with active solar regions over a long period and a second bottle arising to the west of the first may be blocked from producing Forbush effects, while a flare to the east will produce an effect. The boundaries of magnetic bottles and their effect on cosmic radiation at the Earth are discussed, also the interaction of magnetic field bottles at various distances from the Sun, and the magnetic interlocking of two active solar regions. Syrovatskii's criterion (1966) based on plasma concentration is examined, and a formula is developed to estimate the velocity of plasma toward the Sun, which may rise to tens or hundreds of km/sec at some segments of the Earth's orbit. A series of formulas is developed to estimate the energy of magnetic bottles as ranging about 10^{32} erg. (JPRS)

26156 PROGNOSES OF GEOMAGNETIC ACTIVITY AND COSMIC RESEARCH. Halenka, Jaroslav. Stud. Geophys. Geod., 11: 101-5(1967).

The possibilities of using the new method of predicting geomagnetic activity (Bednárova–Nováková 1965) for predicting solar streams of low-energy particles in interplanetary space, defined from the visible solar hemisphere, are discussed. (auth)

26157 SOLAR ACTIVITY IN THE YEAR 1966. Waldmeier, M. (Eidgenoessiche Sternwarte, Zurich). Vierteljahresschr. Naturforsch. Ges. Zuerich, 112: 71-90(Mar. 1967). (In German).

The following data characterize solar activity in 1966 (1965): mean daily sunspot relative number, 47.0 (15.1); lowest sunspot relative number, 0 (0); highest sunspot relative number, 130 (75); mean daily group number, 3.8 (1.3); total number of northern spot groups, 271 (107); total number of southern spot groups, 57 (27); mean equatorial distance of northern sunspots, 22.0°, (25.6°); mean equatorial distance of southern sunspots, 21.9° (26.3°); surface covered by fields of faculae, northern hemisphere, 5.3% (2.3%); surface covered by fields of faculae, southern hemisphere, 0.8% (0.4%); mean equatorial distance of northern faculae, 24.2° (26.9°); mean equatorial distance of southern faculae, 23.0° (27.0°); mean daily profile surface of prominences 3464 (2615); mean daily value of the total emission of the coronal line 5303 Å, 358.2 (150.8); mean daily value of radio emission at 10.7 cm, 102.3, (76.0). Tables give daily values of relative members, group numbers, and radioemission; and distribution in latitude of spots, faculae, prominences, and coronal intensity. Figures show the course of relative numbers and radioemission, and distribution in latitude of spots, faculae, prominences, and coronal intensity. (BBB)

26158 SOLAR CAUSES OF GEOMAGNETIC STORMS WITH A GRADUAL COMMENCEMENT. Bednarova-Novakova, Bohumila. Stud. Geophys. Geod., 11: 106-8(1967).

The new concept of solar–terrestrial relationships developed in Czechoslovakia shows how geomagnetic storms with gradual and with sudden commencement can be detected by continuous observation of the Sun. Further, it explains the formation of some known in the literature as "problem storms." Examples are given. (auth)

26159 SOLAR X RADIATION. Mandel'shtam, S. L. Zemlya Vselennaya, No. 4, 2-10(1967). (In Russian).

Soviet rocket and satellite investigations of solar x radiation are reviewed. Rocket investigations of solar x-ray bursts were initiated in the late 1940s by A. V. Yakovleva of the State Optical Institute and S. L. Mandel'shtam of the Lebedev Physics Institute. On July 21, 1959 a geophysical rocket, measuring in the range 2 to 10 Å, recorded a flux of $\tilde{7} \times 10^{-4}$ erg/cm^2 sec at a height of 92 km. During the total solar eclipse of February 15, 1961, another rocket recorded a flux of 8×10^{-5} erg/cm^2 sec at a height of 96 km. Recently, rockets have succeeded in obtaining x-ray photographs of the Sun at a height of 500 km. Through the use of longer-lived satellites it has been possible to correlate solar x radiation against the 11-year solar activity cycle. Investigations have shown the x radiation to be of a thermal nature and similar in many ways to solar radio emission. It is hoped that further studies of solar x-ray bursts will be useful in developing a reliable solar flare prediction technique. (ATD)

26160 OPTIMIZATION OF REACTOR SHIELDS. Enginol, T. B. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). pp 103-11 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

On an example of a 60 MW power reactor with solid reflector, the shielding was optimized for weight. The shielding consisted of a water layer, a lead–polyethylene layer, and a water layer. The weight-optimized shield was compared to the previous optimization of an iron–water layer. (J.S.R.)

26161 SURVEY OF THEORIES RELATING TO THE ORIGIN OF THE SOLAR SYSTEM. Williams, I. P.; Cremin, A. W. Quart. J. Roy. Astron. Soc., 9: 40-62(Mar. 1968).

After an outline of the major properties of the solar system, a review of both the older and newer theories of the formation of the planetary system of the Sun is presented. (W.D.M.)

26162 THE THEORY OF CEPHEID VARIABILITY. Christy, R. F. Quart. J. Roy. Astron. Soc., 9: 13-39(Mar. 1968).

The discussion is divided into three main parts, of which the first is devoted to methods of investigation. The second part is aimed at understanding the physical causes of pulsation and the mechanism of amplitude limitation. The third part discusses the various results of pulsation calculations. The objective of the third part is to find ways by which all the significant physical parameters (mass, mean effective temperature, mean luminosity, and helium mass fraction) that control pulsation can be deduced from observation of the variable star. (W.D.M.)

26163 HIGH-RESOLUTION SPATIAL CINEMATOGRAPHY OF THE PHOTOSPHERIC GRANULATION. Carlier, Andre; Chauveau, Francois; Hugon, Marcel; Rosch, Jean (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France). Compt. Rend., Ser. A and B, 266: 199-201(Jan. 15, 1968). (In French).

The continuation and development of a program begun in 1954 has

made it possible to obtain regularly images of the photosphere (in large spectral bands of the continuum), in which the spatial resolution can be compared to that of the images obtained by stratospheric balloons, with the double advantage of a much easier and more economical procedure and a collection of data much more abundant in the end. (tr-auth)

26164 NEW VARIABLE STARS AROUND THE GLOBULAR CLUSTERS NGC 6304, 6638, AND 7099 (M 30). Terzan, Agop (Observatoires de Haute Provence et de Lyon, Saint-Genis-Laval, France). Compt. Rend., Ser. A and B, 266: 202-4 (Jan. 15, 1968). (In French).

The study of pictures taken at the Newtonian focus of the 80- and 193-cm telescopes of the Haute Provence Observatory reveals the presence of 25 new variable stars around NGC 6304, 19 around NGC 6638, and 8 around NGC 7099 (M 30). The majority of them seem to have relatively short periods (of the order of one month). (tr-auth)

26165 EAST–WEST STRUCTURE OF RADIO SOURCES AT 1425 MHz. Fomalont, E. B. (California Inst. of Tech., Pasadena, Calif.). Astrophys. J., 15: Suppl. Ser., 203-73(Jan. 1968).

The east–west brightness distributions of over 500 radio sources, 200 of which were resolved, are given in tabular and graphical form. The observations were taken with the California Institute of Technology twin-element interferometer at a frequency of 1425 MHz. Nine separations from 144 wavelengths to 2626 wavelengths were used to synthesize an east–west fan beam of 45″. The description of the observations and a list of the visibility functions of the sources in the observing program were given in a previous paper. (auth)

26166 STELLAR COLLISIONS AND THE EVOLUTION OF ENERGETIC EXTRAGALACTIC OBJECTS. De Young, David Spencer. Ithaca, N. Y., Cornell Univ., 1967. 209p.

Thesis.

The use of stellar collisions as an energy-generating mechanism for extragalactic objects is described, and previous work in the area is reviewed. The evolution of stellar clusters which would lead to stellar collisions is then examined. Consideration of the stars as point masses shows that disruptive collisions occur more frequently than coalescing collisions, and it is found that the addition of cold gaseous debris increases this effect. The presence of hot gaseous debris in the later stages of evolution brings the process to a halt, but before this time sufficient energy has been generated to account for the processes observed in extragalactic radio sources. Stellar collisions in one dimension are then considered, with a similarity solution being used for power law density distributions and a constant pressure approximation for the increasing portion of Gaussian and solar distributions. A freely propagating shock solution is used for the decreasing portion of these distributions, and a difference equation solution is also calculated. The latter shows a relativistic shock velocity occurring when the shock front is about 0.4 solar radii past the center of the star. Nuclear reactions are found not to make a significant energy contribution. A two-dimensional stellar collision is calculated by using slipstreams to subdivide the outflowing material behind the shock front. For a relative collision velocity of 5000 km/sec the shock front becomes relativistic at about 0.9 solar radii past the center of the star, and the fraction of the initial kinetic energy converted into relativistic particles is of the order of 1%. The shock front shows little curvature as it propagates through the star. The evolution of energetic debris produced by such collisions is then considered, in particular the development of a cloud of relativistic particles in the presence of a magnetic field. A cloud injected into the intergalactic medium and a stationary, spherically expanding cloud are both considered. For injection velocities near 0.1 the velocity of light and cloud masses of the order of 10^7 solar masses, the stopping time is of the order of 10^8 years. The magnetic field is considered to be significant only on the boundary, and the dependence of volume, electron energy, and synchrotron luminosity on time is found for both models. The synchrotron luminosity agrees well with observations and requires less total energy than that used in other models. (Diss. Abstr.)

26167 SUPERNOVAE EXPLOSIONS INDUCED BY PAIR PRODUCTION INSTABILITY. Fraley, Gary Scott. Pasadena, Calif., California Inst. of Tech., 1967. 77p.

Thesis.

Stars with a core mass greater than about 30 $M_\odot$ become dynamically unstable due to electron–positron pair production when their central temperature reaches 1.5 to 2.0×10^9 °K. The collapse and subsequent explosion of stars with core masses of 45, 52, and 60 $M_\odot$ is calculated. The range of the final velocity of expansion (3,400 to 8,500 km/sec) and that of the mass ejected (1 to 40 $M_\odot$) is comparable to that observed for type-II supernovae. An implicit scheme of hydrodynamic difference equations (stable for large time steps) used for the calculation of the evolution is described. For fast evolution the turbulence caused by convective instability does not produce the zero entropy gradient and perfect mixing found for slower evolution. A dynamical model of the convection is derived from the equations of motion and then incorporated into the difference equations. (Diss. Abstr.)

26168 THE STRUCTURE OF NGC 6822. Boggess, Nancy Elizabeth Weber. Ann Arbor, Mich., Univ. of Michigan, 1967. 109p.

Thesis.

NGC 6822 is a dwarf irregular galaxy situated in the Local Group. With the exception of the Magellanic Clouds, it is the nearest and most easily observed of the irregular galaxies, and studies of this system are useful for generalizing conclusions based on the Magellanic Clouds to apply them to irregulars at large. The optical appearance of NGC 6822 is that of a prominent bar with five large bright H II regions at its northern end. This study describes the structure of the galaxy and, in particular, the distribution of its Population-I elements. (TSS) (Diss. Abstr.)

26169 OH ABSORPTION IN THE GALAXY. Goss, William Miller. Berkeley, Calif., Univ. of California, 1967. 135p.

Thesis.

A survey of northern hemisphere radio sources for 18-cm OH absorption was completed using the 85-foot Hat Creek telescope of the University of California. The observations were made with the 100-channel receiver with frequency resolutions of 10 kHz (1.8 km/s) and 2 kHz (0.36 km/s). Galactic OH absorption lines were found in 26 galactic sources and two extragalactic sources. Two H II regions were found in the direction of W43 in the 158 α H recombination line. The 158 α He line from the major H II region was detected. In many cases, it is possible to compare the OH absorption lines observed in this investigation with the H I absorption lines found by other observers. The general agreement in velocity suggests that the OH has a similar distribution to the H I. The solution of the equation of transfer appropriate to the OH absorption case is presented. The importance of the isotropic background and the galactic background is stressed. The major processes establishing the excitation of OH in H I regions are considered. Collisions with positive ions and electrons and the 18-cm isotropic radiation field (assumed to be 3°K) dominate the excitation. The calculations predict an excitation temperature of about 20°K while the observational evidence indicates that the excitation temperature is less than about 10°K. Two possible causes for this discrepancy are discussed. For the purpose of the estimation of OH projected densities, it is assumed that the excitation temperature is 3°K (the lower limit). Based on this assumption the ratios of the OH to H I projected densities are in the range 10^{-8} to 10^{-7}. (TSS) (Diss. Abstr.)

26170 SPECTRAL CLASSIFICATION OF CARBON STARS. Gordon, Rebecca Courtney Parks. Ann Arbor, Mich., Univ. of Michigan, 1967. 223p.

Thesis.

The original purpose of this study was to set up a three-dimensional classification system for carbon stars in the red spectral region, taking luminosity, temperature, and carbon abundance into account. The results show: (1) that reliable spectral luminosity indicators are not available and perhaps not necessary (other data place these stars at or somewhat above class III), (2) that most of the carbon stars have the same carbon abundance, and (3) that a one-dimensional classification system based on the stellar surface temperature is sufficient for the vast majority of the carbon stars. 144 carbon stars were studied in the red and/or blue spectral regions at dispersions usually of 88 to 106 A/mm. (TSS) (Diss. Abstr.)

26171 INTERPLANETARY ELECTRON CONTENT MEASURED BETWEEN EARTH AND THE PIONEER VI AND VII SPACECRAFT USING RADIO PROPAGATION EFFECTS. Koehler, Richard Lawton. Stanford, Calif., Stanford Univ., 1967. 124p.

Thesis.

An average interplanetary number density of 4.3 el/cm^3 with an rms variation of ±3.6 was determined from 125 Pioneer VI interplanetary electron content measurements, made from December 1965 through May 1966. The average determined from 170 Pioneer VII measurements made from August 1966 to March 1967 is 8.7 ± 4.0 el/cm^3. The higher average at the later date occurred because interplanetary space was filled more frequently with denser plasma caused by increasing solar activity. The quiet level for Pioneer VII was about 5 el/cm^3, which is near the average for Pioneer VI; these values are in agreement with measurements made locally in interplanetary space by plasma probe experimenters. All of the above measurements apply to regions

of interplanetary space which is within 20% of the distance of Earth from the Sun. Three sudden, large increases in the electron content were observed: October 24, 1966, November 10, 1966, and January 25, 1967. They are explained by a model with a rectangular-shaped increase in electron number density with a spherical wavefront traveling radially from the Sun at 300 to 400 km/sec. The increase in density ranged from 30 to 55 electrons/cm^3 above the background density, extending over a region from 5 to 10×10^6 km along a solar radial. (TSS) (Diss. Abstr.)

26172 BRIGHTNESS DISTRIBUTIONS OF RADIO SOURCES AT 2695 MHz. Bash, Francis Ness. Charlottesville, Va., Univ. of Virginia, 1967. 231p.

Thesis.

Measurements are reported of the fringe amplitude for 234 radio sources using the N. R. A. O. interferometer operating at 2695 MHz. The sources were observed at five antenna separations, 10789λ, 13484λ, 16182λ, 18879λ, and 24274λ, as they crossed the interferometer equator. The source list includes about 50 identified quasi-stellar sources and about 70 identified radio galaxies. Models of the strip brightness distribution were fitted to the observed fringe visibilities for about 190 of the sources. The most complex model used had two components, since with five observations, one is restricted to models with fewer than five degrees of freedom. A description of the instrument, source selection criteria, observing procedures, data reduction procedures, the measured fringe visibilities, the brightness distribution models, and an analysis using angular sizes derived from the models are included. (TSS) (Diss. Abstr.)

26173 SOLAR WIND AND ITS ANGULAR MOMENTUM. Weber, Edmund John. Pasadena, Calif., California Inst. of Tech., 1967. 109p.

Thesis.

A steady-state model is developed for the solar wind in the equatorial plane. Included in the equation of motion are forces due to gravity, viscosity, pressure gradients, and magnetic fields. The electrical conductivity of this plasma is taken to be infinite. Since it is impossible to determine the qualitative features of the solar wind motion from a study of the complete set of equations, a simplified model is treated at first. (TSS) (Disser. Abstr.)

26174 SOLAR PHYSICS. Proceedings of a NATO Advanced Study Institute Conference, Athens, September 1965. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967. 550p. $16.50. (CONF-650993).

Separate abstracts were prepared for the 21 papers presented. (W.D.M.)

For abstracts of individual papers see: 26175–26195.

26175 MODELS OF THE OUTER LAYERS OF THE SUN. Pagel, B. E. J. (Royal Greenwich Observatory, Hailsham, Eng.). pp 1-32 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Theoretical, empirical, and inhomogeneous models and the velocity field of the photosphere are discussed. The solar limb, the chromosphere, and the quiet corona are considered in some detail. (W.D.M.)

26176 COMPOSITION OF THE SOLAR ATMOSPHERE. Mueller, Edith A. (Observatoire de Geneva). pp 33-67 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

In principle, the abundances of chemical elements in the solar atmosphere can be derived in several independent ways: (a) from the Fraunhofer lines; from the emission lines of the far uv spectrum; or (c) for a few elements, from the highly ionized emission lines observed in the visible spectrum of the corona. In this paper, attention is confined to the quantitative analysis of the Fraunhofer lines, which yield the photospheric abundances. (W.D.M.)

26177 SOLAR INFRARED SPECTROMETRY. Migeotte, M. V. (Univ., Liege). pp 69-77 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Solar infrared spectrometry at the University of Liège is reviewed and prospects for improvement in the observational work are considered. (W.D.M.)

26178 ATOMIC IDENTIFICATIONS IN THE SOLAR SPECTRUM FROM λ 7498 TO λ 12,016. A PRELIMINARY REPORT. Swensson, J. W. (Univ., Liege). pp 78-84 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley & Sons, Inc., 1967

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

The results presented in this preliminary note are based on measures of photometric records of the near infrared solar spectrum obtained at the Jungfraujoch Station. An examination of the Jungfraujoch records has revealed over 10,000 absorption lines between λ 7498 and λ 12,016. (W.D.M.)

26179 MOLECULAR IDENTIFICATIONS IN THE SOLAR SPECTRUM FROM λ 7498 TO λ 12,016: A PRELIMINARY REPORT. Benedict, W. S. (Johns Hopkins Univ., Baltimore). pp 85-8 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

A brief report is given which summarizes the present status of the molecular identifications in the table of measured lines in the Jungfraujoch solar spectra, 7498 to 12,016 Å, as observed by Delboville and Roland (1963). (W.D.M.)

26180 PRESENCE OF FORBIDDEN LINES OF IONIZED IRON IN THE SOLAR ABSORPTION SPECTRUM. Swings, J. P. (Institut d' Astrophysique, Cointe-Sclessin, Belgium). pp 89-93 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

On account of controversies (Cabannes and Dufay, Garstang, Warner, and Kodaira) an attempt is made to rediscuss the problem of solar Fe II using more precise observations than those published in Rowland's Table or in the Atlas Photometrique d'Utrecht. (W.D.M.)

26181 NONHOMOGENEOUS STRUCTURE OF THE SOLAR ATMOSPHERE. Michard, R. (Meudon Observatory, Paris). pp 95-131 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Interpretation of the "average" solar spectrum through the use of inhomogeneous models is considered in terms of equivalent widths, profiles, and asymmetric profiles and heterogeneous models. Direct observation of heterogeneities is covered under granulation, jagged Fraunhofer lines, radial velocity distribution on the disk, oscillations, photometric fluctuations in the lines, spicules, time power spectra, two-dimensional power spectra, phase propagation in the V field, time relations between the V field and the granulation, and brightness fluctuations in the lines. (W.D.M.)

26182 SHOCK WAVES IN THE SOLAR ATMOSPHERE. Schatzman, E. (Institut d' Astrophysique, Paris). pp 133-56 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Attention is given to the formation and propagation of a shock wave in the solar atmosphere, including the essential problem of the thermodynamics of the shock, and its dissipation. A few indications concerning the heating of the solar chromosphere are given. Only the case without magnetic field is considered. (W.D.M.)

26183 DIFFERENT INDICES OF SOLAR ACTIVITY AND THE TIME OF RISE. Xanthakis, John (Research and Computing Centre, Athens). pp 157-227 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

The relative sunspot numbers are discussed in terms of the maxima of the mean annual sunspot numbers, the mean annual relative sunspot numbers, the maxima of the mean monthly relative sunspot numbers observed during the year of maximum solar activity, the maxima of the smoothed mean monthly relative sunspot numbers corresponding to the year of maximum solar activity, the minima of the mean monthly relative sunspot numbers observed during the year of maximum solar activity, and the highest and lowest values of the mean monthly relative sunspot numbers observed during each year. The areas of whole sunspots, umbrae, faculae, and prominences are considered. The maxima of the annual values of the sums of the maximum sunspot magnetic field strengths and the annual values of the sums of the maximum sunspot magnetic field strengths are discussed in some detail. The differential equations of the indices of solar activity are given. (W.D.M.)

26184 SUNSPOT SPECTROSCOPY. Zwaan, C. (Sonnenborgh Observatory, Utrecht). pp 229-54 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

From the study of sunspot spectra one may obtain an empirical sunspot model, i.e., the dependence of the temperature on the optical depth, the pressure distribution, and the magnetic field. Until the present, most attention has been paid to the spectra of umbrae. In this review attention is restricted mainly to a discussion of the continuous spectrum and the equivalent widths of atomic and ionic lines. (W.D.M.)

26185 SPECTROSCOPIC DETERMINATIONS OF SOLAR MAGNETIC FIELDS. von Klueber, H. (Cambridge Univ., Eng.). pp 255-304 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

A short outline is given of the different methods so far developed for the spectroscopic determination of solar magnetic fields. No attempt is made to describe the results in detail. (W.D.M.)

26186 ON THE SUN'S POLAR MAGNETIC FIELDS. Godoli, Giovanni (Observatorio Astrofisico di Arcetri, Florence). pp 305-23 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

The first speculations on the existence of a solar general magnetic field were suggested by the shape of the polar rays. As is known, the polar rays are short, brush-like plumes of the corona observed at the polar regions on high-resolution photographs taken during eclipses near the minimum phase of the activity cycle. A short review of past work is given. (W.D.M.)

26187 EVERSHED EFFECT IN SUNSPOTS. Schroeter, E. H. (Univ., Goettingen, Ger.). pp 325-51 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Observational results up to 1955 (low- and moderate-resolution spectra) and observations of the last 10 years (high-resolution spectra), which includes observational evidence for a relation of the Evershed effect with motions in penumbral fine structures, are reviewed. Theoretical considerations are briefly discussed. (W.D.M.)

26188 STRUCTURE OF THE NORMAL CHROMOSPHERE. Giovanelli, R. G. (Commonwealth Scientific and Industrial Research Organization, Sydney). pp 353-81 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

From direct observation of the fine structures on the limb and on the disk, characteristic properties are given for Hα bright mottles and the spicules which are their upward extensions. The spicules are at 20,000°K or more, with electron densities of a few $10^{10}/cm^3$ at 6000 km. The dark mottles are cooler, $T < 2 \times 10^4$°K, and denser than the bright. It is noted that for comparable heights, the pressures are much the same in dark mottles and bright, while there is the important check that for the bright mottles up to 10,000 km the pressure decreases continuously with height. (W.D.M.)

26189 MORPHOLOGY OF AN ACTIVE REGION ON THE SUN. Kiepenheuer, K. O. (Fraunhofer Institut, Freiburg i. B.). pp 383-98 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

The difficulty in obtaining a synopsis of an active region on the Sun lies in the great variety of phenomena involved and in the variety of specialized instruments necessary to observe the photospheric, chromospheric, and coronal features. It is also caused by inadequate spatial resolution, mostly due to the seeing effects of the atmosphere. These problems are discussed and an attempt is made to provide a physical interpretation of an active region. (W.D.M.)

26190 PHYSICS OF SOLAR FLARES: THE ENERGY AND MASS PROBLEM. Bruzek, A. (Fraunhofer Institut, Freiburg i. B.). pp 399-421 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Discussion is confined to the basic problem of the physics of the solar flare, i.e., the energy and mass supply. Relevant flare observations are considered strictly from the viewpoint of what they can possibly tell about that fundamental problem. (W.D.M.)

26191 SOLAR CORONA. Rosch, J. (Univ., Paris). pp 423-45 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

An attempt is made to provide a survey of the information obtained by observation. The present limit beyond which it is no longer safe as a basis for theory is pointed out. The general appearance and structure of the corona during an eclipse and methods of investigation are discussed. Determination of the electron density and temperature is considered. (W.D.M.)

26192 CONTINUOUS SPECTRUM OF THE CORONA. Rigutti, M. (Osservatorio Astrofisico, Arcetri, Italy). pp 447-63 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Most of the coronal light comes from an intense continuous spectrum (99%). Superimposed on the continuum are an emission-line spectrum due to highly ionized atoms and, from about 5′ to 10′ from the solar limb, an absorption-line spectrum. In this study the emission-line spectrum is not considered. Attention is concentrated on the continuum and the absorption-line spectrum (K and F coronas). (W.D.M.)

26193 SOLAR RADIO ASTRONOMY. Boischot, A. (Observatoire de Meudon, France). pp 465-81 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

The few results mentioned in this paper are intended to show the interest of observing solar radio emission, relative to both solar physics and terrestrial effects. Radio observation of the sun cannot be separated from its optical study, but it leads to a better understanding of certain phenomena, which the observation of the visible radiation originating mainly in the photosphere or very low chromosphere, cannot show clearly. (W.D.M.)

26194 DUST DYNAMICS IN THE MAGNETOSPHERE AND INTERPLANETARY SPACE. Singer, S. Fred (Univ. of Miami, Coral Gables, Fla.). pp 483-91 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

Evidence regarding the size distribution and other properties of interplanetary dust comes from different types of observation: optical observations of zodiacal light; impacts of dust particles on satellite detectors; and collection of dust in the ionosphere and stratosphere. The influences of radiation pressure, Coulomb drag, and the Lorentz force are discussed. (W.D.M.)

26195 SPACE SOLAR PHYSICS. Goldberg, Leo (Harvard Coll. Observatory, Cambridge, Mass.). pp 493-520 of Solar Physics. Xanthakis, John N. (ed.). New York, John Wiley and Sons, Inc., 1967.

From Proceedings of a NATO Advanced Study Institute on Solar Physics, Athens. See CONF-650993.

The advantages of studying the Sun from space platforms above the Earth's atmosphere are enumerated. A description is given of the goals of space solar physics and the progress that has been made so far is described. (W.D.M.)

26196 MANTLES OF THE EARTH AND TERRESTRIAL PLANETS. Conference held at the University of Newcastle-upon-Tyne, England, 30 March–7 April 1966. Runcorn, S. K. (ed.). New York, Interscience Publishers, 1967. 593p. $25.00. (CONF-660331).

Separate abstracts were prepared for three of the fifty-four papers presented. The papers not abstracted concern properties of the planets, planetary rotation, origin and properties of the Moon, geochemical evidence on the nature of the Earth's mantle, surface evidence relating to planetary evolution, and thermal convection in planets. (A.G.W.)

For abstracts of individual papers see: 26109, 26197, and 26198.

26197 RARE-GAS ISOTOPE STUDIES ON METEORITES. Laemmerzahl, P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 49-61 of Mantles of the Earth and Terrestrial Planets. Runcorn, S. K. (ed.). New York, Interscience Publishers, 1967.

From Mantles of the Earth and Terrestrial Planets Meeting, Newcastle-upon-Tyne, Eng. See CONF-660331.

A brief outline of rare gas isotope studies on meteorites is presented, with emphasis on recent contributions from the Max-Planck-Institut fur Kernphysik. Primordial rare gases, radiogenic

isotopes, and spallogenic isotopes and their implications with regard to the origin and evolution of the meteorites are considered. (55 references.) (A.G.W.)

26198 ABUNDANCE OF COSMIC DUST. Grjebine, T. (Centre des Faibles Radioactivites, Gif-sur-Yvette, France). pp 63-74 of Mantles of the Earth and Terrestrial Planets. Runcorn, S. K. (ed.). New York, Interscience Publishers, 1967.

From Mantles of the Earth and Terrestrial Planets Meeting, Newcastle-upon-Tyne, Eng. See CONF-660331.

Methods of measuring the accretion rate of cosmic dust on Earth are reviewed, and estimates obtained by different investigators since 1941 are tabulated. Comparison of the results is made difficult by the fact that most techniques measure only the dust particles in a particular size range. It is concluded, however, that a value of some 2×10^8 tons/Earth year can fit all the different determinations within a factor of 10 exp (±1). (A.G.W.)

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Refer also to abstracts 25711, 26474, 26477–26479, 26572, 26924, 27039, 27040, 27087, and 27269.

26199 (BNWL-SA-1535) THE DYNAMICS OF LIQUID H_2O AND D_2O AND SOLID H_2O FROM THE INELASTIC SCATTERING OF EPITHERMAL NEUTRONS. Harling, O. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 29, 1968. Contract AT(45-1)-1830. 21p. (CONF-680501-3). Dep. CFSTI.

From Symposium on Inelastic Neutron Scattering, Copenhagen, Denmark.

An extensive series of neutron inelastic scattering measurements has been made on liquid H_2O and D_2O at 299°K and on solid H_2O at 268°K. Double differential cross sections for H_2O were obtained for energy transfers to 0.6 eV and momentum wave vector transfers ($\Delta\beta/\hbar$) to 32Å^{-1} while for D_2O the energy and momentum transfer range was 0.2 eV and 9.5 Å^{-1}, respectively. All measurements were obtained with the Battelle rotating-crystal spectrometer using initial neutron energies of 0.616 to 0.101 eV. Scattering angles ranged from 15 to 165°. The measured differential cross sections exhibit considerable structure in energy corresponding to the torsional motions and the intramolecular bending and stretching modes of the H_2O molecule. Instrumental resolution was adequate to obtain information about the widths of some of these transitions. The angular dependence of scattering associated with the excitation of a definite mode, in a solid or liquid, can be expected to depend upon the shape of the potential well in which the dynamical unit moves. In the case of the present measurements on ice, it was possible to determine the angular dependence of the inelastic scattering from the torsional band.. The experimental differential cross section for excitation of these modes is found to be in good agreement with the angular dependence calculated for inelastic scattering from a symmetric harmonic oscillator potential. Spectral density functions for the proton and deuteron have been obtained using an extrapolation technique. These density functions extend to higher energy transfers than previously published neutron results, and include the intramolecular bending modes of the water molecule. The mean squared amplitudes of the proton and deuteron clouds are derived from the spectral density functions. These amplitudes are found to be in good agreement with neutron diffraction studies of D_2O but are considerably smaller than values obtained by other investigators who measured the Debye–Waller factor for quasi-elastically scattered slow neutrons. (auth)

26200 (NP-15967(Suppl.)) BIBLIOGRAPHY ON ATOMIC TRANSITION PROBABILITIES, MAY 1966 THROUGH DECEMBER 1967. Glennon, B. M.; Wiese, W. L. (National Bureau of Standards, Washington, D. C.). Apr. 1968. 45p. GPO $0.30.

A supplement to NP-15967 (NBS-MISC. PUBL.-278) is presented, which covers the most recent literature on this subject from May 1966 through December 1967. The papers are arranged according to elements and stages of ionization, and the method employed and class of transitions are indicated behind each reference. Only articles on discrete transitions, both allowed and forbidden, are listed. Papers containing data for more than 20 individual elements or stages of ionization are collected separately in front of the list in order to keep this bibliography at a reasonable size. Also included is a selected list of papers dealing with the subject of transition probabilities from a general point of view. (auth)

26201 (NP-17363) INTERACCION ESPIN-ESPIN ENTRE LOS NUCLEOS DE LA MOLECULA DE HIDROGENO. (Spin-Spin Interaction Between the Nuclei of the Hydrogen Molecule). Terc Kouri, Nemen Michel (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1966. 47p. (In Spanish). Dep.

Thesis.

The spin–spin interaction between the nuclei of the hydrogen molecule was studied theoretically by using a Hamiltonian for the hydrogen molecule. The Hamiltonian is divided into one part which depends on the electrostatic interaction and is then used as the nonperturbed part. The other part contains the corrections due to the magnetic fields and other effects. The Schroedinger equation for the hydrogen molecule with the nonperturbed Hamiltonian is established. The adiabatic approximation of Born and Oppenheimer is used to resolve this equation. The model used to take into consideration the correction to the energy due to the spin–spin interaction is explained and the frequency which makes it possible to obtain such energy is calculated. The molecular beam method and the Rabi radiofrequency method for the experimental measurement of the spin–spin interaction are described in detail. The resonance curves are explained. The Ramsey experimental results are compared with the theoretical results with good agreement. (J.S.R.)

26202 (UCRL-17391(Rev.)) PROGRAM BRAGG: A FORTRAN-IV PROGRAM FOR CALCULATING BRAGG CURVES, FLUX, AND CURRENT DISTRIBUTIONS, AND ENERGY SPECTRA. Litton, Gerald M. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 5, 1968. Contract W-7405-eng-48. 23p. Dep. CFSTI.

Program BRAGG is an extension of a program described earlier in a version of this report (see NSA 21: 31199). Some of the basic differences between the earlier and the current versions of BRAGG are inclusion of effects due to angular and energy distributions in the initial beam, and an option for inclusion of geometric attenuation of the beam as a result of beam spreading. (M.O.W.)

26203 (NP-tr-1631) DETERMINATION OF THE PENETRATION COEFFICIENT OF FAST H_1^+ IONS INTO METALS BY THE CONDENSATION METHOD. Borovik, E. S.; Katrich, N. P.; Nikolaev, G. T. Translated for Culham Lab., Abingdon, Eng., from At. Energ. (USSR), 23: 102-5(Aug.-Sept. 1967). 8p. (CTO-451). Dep. CFSTI. UK. JCL $1.10 fs, $0.80 mf.

An abstract from the original paper appeared previously in NSA as 22: 7166. (M.O.W.)

26204 QUADRATIC STARK EFFECT CONSTANTS. Voeroes, T.; Petrakev, A.; Kluge, K.; Koernyei, I. (Hungarian Academy of Sciences, Sofia. Univ. for Economic Sciences Computing Centre, Budapest. Univ. of Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1267-70(1967).

Using quantum mechanical calculations for the lives of 13 elements, the quadratic Stark effect constants were calculated. The theoretical results are in rather good agreement with the experimental values. (W.D.M.)

26205 EFFECTIVE MASS OF THE POSITRON IN METALS. Majumdar, Chanchal K. (Tata Inst. of Fundamental Research, Bombay). pp 187-95 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.1).

The calculated and measured values of the effective mass m_+^* of the positron in metals do not agree. The experiment is made feasible by the fact that there is a sharp break in the angular correlation curve of the annihilation γ rays at the Fermi momentum. It consists in a study of the temperature dependence of the angular correlation curve to find how this break disappears with rise of temperature. Experimental values in alkali metals are rather high; for instance $m_+^* = (1.9 \pm 0.4)m$ in Na, where m is the free positron mass. Two effects must be considered in calculating m_+^*. First, the positron moves in the periodic potential of the solid (the band effective mass). This comes out to be $m_+^*/m = 1.06$ for Na and similar values close to 1 for other materials, when calculated by the Wigner, Seitz and Bardeen method. Secondly, the positron interacts with electrons and phonons in the solid. Electronic interaction has been treated by the techniques of modern many-body theory and yields $m_+^*/m \approx 1.18$ for Na. Phonon contribution is expected to be small. As the theoretical calculations are based on reliable procedure, the disagreement is surprising. Some possible reasons for this are discussed. (auth)

26206 MAGNETIC HYPERFINE STRUCTURE IN ^{125}Te. Frankel, R. B.; Huntzicker, J. J.; Shirley, D. A.; Stone, N. J. (Univ. of California, Berkeley). Phys. Lett., 26A: 452-3(Apr. 8, 1968). (UCRL-18064).

Mössbauer spectra of ^{125}TeFe with improved resolution yield $\mu(35.5\ \text{keV}) = +0.60 \pm 0.02$ nm. The effect of this value on hyperfine spectra of ^{125}Te are discussed. (auth)

26207 POSITRON ANNIHILATION IN CONDENSED MEDIA. Chandra, Girish; Kulkarni, V. G.; Lagu, R. G.; Thosar, B. V. (Tata Inst. of Fundamental Research, Bombay). pp 196-206 of Proceedings of the Nuclear Physics and Solid State Physics Sym-

posium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.1).

The value (τ_2) and the intensity (I_2) of the slow component in the lifetime of positrons has been studied in various condensed media. These results show a correlation between τ_2 and I_2, i.e., as τ_2 increases, I_2 decreases. The correlation curves for solid polymers and for liquids and amorphous solids are presented. It is shown that from theoretical considerations, one can evaluate the probability of positronium formation and the rate of three-quantum annihilation in such media, using the experimentally measured values of I_2 and τ_2. A few simple and plausible assumptions have been made regarding the nature of the condensed, amorphous media, which explain the observed correlation between I_2 and τ_2. A large number of experimental results regarding I_2, τ_2 and three-photon annihilation rate is surveyed, and is shown to be consistent with the model developed. (auth)

26208 VERY SLOW PIONIC PROBES IN THE STUDY OF SOME SOLID-STATE PHENOMENA. Ammiraju, P. (Tata Inst. of Fundamental Research, Bombay). pp 207-10 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.1).

The capture probability of very slow pions in nuclei depends on the potential seen by the pion in the solid. The bearing of alteration, produced by chemical binding, on the outer regions of the atoms is discussed. (auth)

26209 FIELD-CORRELATION EFFECTS IN TWO-PHOTON PROCESSES. Lambropoulos, P. (Bendix Research Labs., Southfield, Mich.). Phys. Rev., 168: 1418-23(Apr. 25, 1968).

The rate of two-photon absorption from an arbitrary state of the radiation field, and its dependence on the statistical properties of the field, are studied. It is found that when the density operator of the field factors into a product of single-mode density operators (in which case the modes are statistically independent), the rate depends on the spectral composition of the field. When the density operator is nonfactorable, the process depends on a photon doublet density. Therefore, the information obtained from two-photon experiments in the first case can, in principle, also be obtained from single-photon counting, while in the second case it would require coincidence counting. (auth)

26210 BOUNDARIES OF QUANTUM ELECTRODYNAMICS AND THE PRECISION OF THE UNIVERSAL CONSTANTS. Smorodinskii, Ya. A. Usp. Fiz. Nauk, 94: 359-60(Feb. 1968). (In Russian).

The fine-structure constants were measured by means of the Josephson effect which involves the description of the superconductive state by a wave function based on macroscopic distances. The new value of the fine structure constant, $1/\alpha = 137.0359$, eliminates the divergence between theoretical and experimental data concerning the Lamb shift. On the basis of the new value of α, the Lamb value is 1057.57 ± 0.08 Mhz, as compared with the theoretical value of 1057.77 ± 0.10 Mhz. The position of the ground state of hydrogen with hyperfine structure splitting is of special interest. Transition between the 0 and 1 spin levels generates the 21-cm line, well known in radioastronomy; this value is known with great precision as $\gamma = 1420405751.800 \pm 0.028$ hz. (TTT)

26211 COLLECTIVE EFFECTS IN ATOMS. Roulet, B.; Nozieres, P. J. Phys. (Paris), 29: 167-80(Feb.-Mar. 1968). (In French).

The linear response of atoms to an external field is formulated in the random-phase approximation. The connection with the configuration interaction theory between a discrete state and a continuum is indicated. The problem of the screen effect is analyzed for one electronic shell in three limited cases depending on the values of the wave vector and frequency of the applied field. (auth)

26212 THEORETICAL AND EXPERIMENTAL STUDY OF THE LUMINESCENCE OF ARGON INDUCED BY α PARTICLES. Henck, R.; Voltz, R. (Rayonnements et d'Electronique Nucleaire, Strasbourg-Cronenbourg, France). J. Phys. (Paris), 29: 149-58 (Feb.-Mar. 1968). (In French).

An analysis of the nature and of the evolution of the atomic states excited in argon by fast ionizing particles leads to the conclusion that the radioluminescence of the gas at pressures of the order of one atmosphere is due to a radiative emission from excited dimers A_2^{**}. These dimers are formed in three-body collisions involving an atom A^{**} excited in a state belonging to the configuration $(3p)^5$ 5s or $(3p)^5$ 3d. This is in agreement with the experimental results on the fluorescence spectra and decay times, obtained by methods which are briefly described. It is found that the mean lifetimes of the excited atom A^{**} and dimer A_2^{**} are respectively equal to 10^{-7} s and to 6×10^{-9} s. The rate constant of the ternary collision producing the excited dimers is found to be 22×10^{-32} cm^6 s^{-1}. The numerical values thus obtained are discussed. (auth)

26213 RELATIVISTIC CURRENT OF THE H ATOM IN O(4,2) DYNAMICS. Kleinert, Hagen (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., 168: 1827-32(Apr. 25, 1968).

A relativistic current operator is given in the O(4,2) description of the H atom whose matrix elements reduce to the correct Galilean form in the limit $c \to \infty$. This current is used to obtain a relativistic wave equation which contains the H-atom states as solutions and in which the electromagnetic field is coupled minimally. (auth)

26214 METHOD OF MEASURING ION BEAM PROFILES. Inouye, H.; Boerboom, A. J. H. (Inst. for Atomic and Molecular Physics, Amsterdam). J. Phys., E, 1: 484-6(Apr. 1968).

The curves of measured beam intensity of given profiles with a large detector hole are first calculated by representing the detector as a cylinder and the ion beam as a cylinder, a cone, or a truncated cone, and then calculating the common volume as a function of the interaxial distance. The original beam profile is obtained by comparing the experimental curve with the calculated curves. (auth) (UK)

26215 ENERGY DISTRIBUTION OF ENERGETIC ATOMS IN A GASEOUS MEDIUM. II. ELASTIC SCATTERING BY A SPHERICAL TWO-TERM POTENTIAL COMPOSED OF A HARD AND A SOFT TERM. Baer, M. (Soreq Nuclear Research Center, Yavne, Israel). J. Chem. Phys., 48: 2786-99(Mar. 15, 1968).

The energy distribution function $n(E)$ for energetic particles in a gaseous medium is treated (classically), assuming the particles to be scattered by a potential of the form $V(r) = \infty$; $0 \le r \le R = A/r^s$; $R < r \le \infty$. The function $n(E)$ is computed using the Boltzmann integral equation with the probability function $g(E,E')$ as the kernel. A method is described for the computation of $g(E,E')$ for a potential $V(r) + \Delta V(r)$ if it is known for the potential $V(r)$. This method is used to represent $g(E,E')$ in an analytic explicit form for the above potential. Substituting $g(E,E')$ in the Boltzmann equation, the function $n(E)$ is computed following some approximations. (auth)

26216 GASEOUS ION RECOMBINATION. V. Mahan, Bruce H. (Univ. of California, Berkeley). J. Chem. Phys., 48: 2629-32(Mar. 15, 1968).

Pitaevski's formulation of the three-body ion–electron recombination rate constant based on the Fokker–Planck equation is modified so as to apply to the termolecular association of gaseous ions. The theory is expected to be valid when the collisional energy changes are small compared to the kinetic energy of the recombining ions, which occurs when the mass of the neutral is much less than the masses of the ions. The calculated and measured rate constants for such systems are in substantial agreement. (auth)

26217 MAGNETIC RESONANCE IN OPTICALLY ORIENTED ^{3}He. Pokazan'ev, V. G.; Yakub, L. I.; Skrotskii, G. V. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 239-43(1968). (In Russian).

The magnetic resonance in the system of optically oriented ^{3}He atoms is considered. The possibility of observing the magnetic transitions in orthohelium and nuclear system of parahelium is discussed. (auth)

26218 TIME-OF-FLIGHT DETERMINATION OF THE DIFFUSION COEFFICIENT OF Cs_2^+ IONS IN CAESIUM VAPOURS. Popescu, I.; Niculescu, N.; Popescu, A. (Inst. of Physics, Bucharest). J. Phys., D, 1: 313-17(Mar. 1968).

The technique used employed a pulsed ion source and hot-wire detector. This allowed a direct evaluation of the normalized zero electric field mobility of $\mu_0 \simeq 0.28$ cm^2 v^{-1} s^{-1} over the approximate temperature range 500 to 590°K. (auth) (UK)

26219 PROJECTED RANGES OF LIGHT IONS IN HEAVY SUBSTANCES. Schioett, Hans E. (Univ. of Aarhus, Denmark). Can. J. Phys., 46: 449-53(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Computer programs have been worked out for the calculation of projected ranges of low-energy ions by means of the theory of Lindhard, Scharff, and Schiøtt. The stopping substance is assumed to be a random system and may consist of several elements. In the case of a monatomic stopping substance, the program includes a calculation of the straggling in projected range. Comparisons are

made with measurements of projected ranges, from which semi-empirical estimates of electronic stopping may be made. (auth)

26220 RANGES OF PROJECTILES IN AMORPHOUS MATERIALS. Sanders, J. B. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam). Can. J. Phys., 46: 455-65(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

By using an inverse power-law approximation for the interaction potential between a fast-moving projectile and the atoms of an amorphous target into which it penetrates, it is possible to calculate moments of any order of different combinations of range quantities as functions of the initial kinetic energy of the projectile. By the moment of order n of a statistically distributed quantity X is meant the average value of X^n. The quantities concerned are the projection of the total distance from its point of entrance, reached by the projectile on its initial direction of motion, and the projection on the plane, perpendicular to this direction. From these moments, a distribution function of the penetration depth can be constructed. This calculation has been performed for ^{85}Kr ions entering amorphous Al_2O_3 with different energies. The result is compared with measurements made by Domeij et al. (auth)

26221 THE RANGES OF 5 TO 80-keV DEUTERIUM IONS IN GOLD AND ALUMINUM. Freeman, N. J.; Latimer, I. D. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Can. J. Phys., 46: 467-72(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The depth distribution of deuterium in metal targets has been measured by sputtering the metal surface with a 60-keV Bi beam and monitoring the partial pressure of deuterium released into the target chamber with an MS 10 mass spectrometer. No significant differences were found for the distributions from D^+, D_2^+, and D_3^+ bombardments with 20 and 30 keV energy per incident atom. The sputtering coefficient, measured by the loss in weight of a target, was used to calculate ranges for the energy interval 5 to 80 keV. These are compared with previous experimental and theoretical values. (auth) (Canada)

26222 SPUTTERING AND DEPTH-DISTRIBUTION PHENOMENA IN KCl, Al_2O_3, AND TiO_2. Kelly, Roger (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 46: 473-82(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

If a solid is bombarded with an inert gas, the thickness removed by sputtering is proportional to (S) (μA min/cm^2), where S is the sputtering coefficient. This effect was used first to evaluate S for $Kr-Al_2O_3$, $O_2-Al_2O_3$, $Kr-TiO_2$, and O_2-TiO_2 in the region 2 to 10 keV. With Al_2O_3, pieces of free anodic oxide were bombarded until perforated, while with TiO_2 the changes in the interference colors of anodized Ti were noted. Knowing the values of S, depth distributions were obtained for 10-keV Kr in KCl, Al_2O_3, and TiO_2 at doses of 1 to 50 μA min/cm^2, the amount of Kr remaining in the targets being determined by radioactivity measurements. R_m, the median range, was 105 Å with KCl, and thus within a factor-of-2 agreement of other range data for crystalline materials; with Al_2O_3 and TiO_2, however, R_m was only 11 to 18 Å, and thus a factor of 4 to 6 lower than expected on the basis of low-dose data for anodic oxides. In the case of Al_2O_3, the low values of R_m were explicitly shown to be due in part to a dose effect, such that R_m is at least a factor of 2.3 lower for doses over 1 μA min/cm^2, and similar behavior can probably be assumed also for TiO_2. In addition, however, gas sputtering or surface roughening may possibly play a role with Al_2O_3 and TiO_2. (auth)

26223 RANGE STUDIES USING A NEW CHEMICAL FILM TECHNIQUE. Andersen, T.; Soerensen, G. (Univ. of Aarhus, Denmark). Can. J. Phys., 46: 483-8(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The formation and stripping of corrosion films produced by immersion of metal foils of Cu, Ag, Au, Sn, or Pb in organic solvents containing corrosive agents such as iodine or bromine have been studied using a radioactive tracer technique. The data show that the formation and stripping of metal–halogen films may be a suitable method for the peeling of layers from 0.5- to 30-μg/cm^2 metal. The film technique has been applied for Cu and Au, using iodine in chloroform as the corrosive agent and potassium iodide as the stripping solution for Cu, whereas bromine in carbon tetrachloride or bromine vapor was used as the corrosive agent for Au, with chloroform as the stripping agent. Experimental range data of ^{24}Na, ^{32}P, and ^{42}K in gold at energies higher than 100 keV are reported and compared with theory. (auth)

26224 STOPPING CROSS SECTION IN ATMOSPHERIC AIR OF 0.2 TO 0.5 MeV ATOMS WITH $6 \leq Z_1 \leq 24$. Fastrup, B.; Borup, A.; Hvelplund, P. (Univ. of Aarhus, Denmark). Can. J. Phys., 46: 489-95(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The stopping cross section $S = dE/NdR$ in atmospheric air has been measured for ions with $6 \leq Z_1 \leq 24$ and energy ranging from 0.2 to 0.5 MeV. The experimental data have been corrected numerically for nuclear stopping, and the electronic stopping cross sections S_e obtained are compared with theory. The previously reported periodic dependence of S_e in solids on the atomic number Z_1 of the incoming ion for constant velocity is also seen in the present data for a gas target. The structure of the oscillations is found to be insensitive to whether the target is a solid or a gas. Some preliminary measurements of the charge-state distributions of the ions emerging from the gas target for various Z_1 values are discussed. (auth)

26225 LOW-ENERGY ELECTRONIC STOPPING CROSS SECTIONS IN NITROGEN AND ARGON. Ormrod, J. H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 46: 497-502(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The rate of energy loss in nitrogen and argon targets for ions with $Z \leq 10$ and $E < 200$ keV has been measured. The contribution to the energy loss from nuclear stopping was calculated using Fastrup's method, and was subtracted from the observed stopping cross section to give the electronic stopping cross section. Over the energy interval studied, the electronic stopping cross sections obtained are below the theoretical values and the energy dependence in argon is much greater than $E^{\frac{1}{2}}$. A target gas pressure of ~10 μ was used. This reduces the collision frequency eight orders of magnitude below that in a solid. The periodic dependence of the electronic stopping cross section on the atomic number of the incident projectile, previously observed in solid targets, occurs also for such low-pressure gas targets; it is concluded that this dependence is not affected by the collision frequency. (auth)

26226 SPUTTERING EFFICIENCY OF AMORPHOUS SUBSTANCES. Sigmund, Peter (Kernforschungsanlage Juelich, Ger.). Can. J. Phys., 46: 731-7(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Sputtering efficiency is defined as the fraction of bombarding ion energy leaving a crystal via sputtering and backscattering. This quantity is calculated for the case of perpendicular incidence on a random medium with plane surface. Use is made of the spatial distribution of deposited energy as calculated by Sanders and the author. In the elastic collision region but above about 1 keV, the sputtering efficiency is predicted to be essentially independent of ion energy and to depend only on the mass ratio. For self-sputtering it should be 2.4% and increase with decreasing ion mass. The predictions appear to be consistent with existing experimental results, but a few direct checks are desirable. Qualitative arguments suggest that, in the case of single crystals, lattice effects with respect to the incoming beam are more pronounced in the sputtering efficiency than in the yield. Reversely, ejection patterns of sputtered energy should reveal less influence of lattice structure than those of sputtered intensity. The latter result is consistent with experiment. (auth)

26227 MASS AND ENERGY ANALYSIS OF POSITIVE IONS EMITTED FROM METALLIC TARGETS BOMBARDED BY HEAVY IONS IN THE keV ENERGY REGION. Jurela, Z.; Perovic, B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Can. J. Phys., 46: 773-8(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Mass spectra of positive ions emitted from polycrystalline metallic targets (Al, Mn, Co, Ta) were analyzed by the mass spectrometric method when the targets were bombarded by the analyzed Ar^+ ion beam of 40-keV energy. Single- and multiple-charged atomic components, as well as single-charged molecular components, were detected. The energy distribution curves for some mass-spectra components, measured by the retarding potential method, are presented. (auth)

26228 ION REFLECTION FROM A SINGLE CRYSTAL. Yurasova, V. E.; Shulga, V. I.; Karpuzov, D. S. (Moscow State Univ.). Can. J. Phys., 46: 759-72(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The scattering of Ar, Ne, and He ions from the Cu {100} face has been investigated by a digital computer technique; only binary elastic collisions of ions with the lattice atoms have been considered; the angular and energy distribution at various directions of incidence are discussed. The scattering by surface atomic chains and its contribution to the general picture of ion reflection were also studied. (auth)

26229 THE ANGULAR DISTRIBUTION OF SCATTERED AND SPUTTERED 40-keV PARTICLES ON POLYCRYSTALLINE TARGETS. Formann, E.; Viehboeck, F. P.; Wotke, H. (Reactor Center Seibersdorf, Austria). Can. J. Phys., 46: 753-8(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Calculations based on the hard-sphere potential approximation were made for angular distributions of scattered particles at different mass ratios $M_1 : M_2$. The results were compared with experiments carried out with Mg^+ and Kr^+ on Al, Mo, and Ta and Gd^+ on Al and Ta. The sputtered particles from the target as well as from the incident ion beam were collected on graphite rods and measured by either activation analysis or a radioactive tracer technique. (auth)

26230 ROLE OF FOCUSING COLLISIONS IN SPUTTERING. Nelson, R. S.; von Jan, R. (Atomic Energy Research Establishment, Harwell, Eng.). Can. J. Phys., 46: 747-51(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

A theoretical model provides a better understanding of the mechanism of sputtering from close-packed crystal directions, for high-energy sputtering in particular. The results show that focusing collisions must play a major part in producing the observed preferential ejection and that the contribution of long-range sequences is important for materials with high focusing energies. The model also provides information on the influence of thermal vibrations. (auth)

26231 SINGLE-CRYSTAL SPUTTERING INCLUDING THE CHANNELING PHENOMENON. Onderdelinden, D. (Fundamenteel Onderzoek der Materie, Amsterdam). Can. J. Phys., 46: 739-45(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Measurements of the angular behavior of the sputtering ratio for Ar^+ on (100) Cu turned around a [011] axis are presented for Ar^+ energies of 5, 10, 15, 20, and 35 keV. It is shown that the widths of the [100] minima can be related to the acceptance angle for channeling, as described by the theory of Lindhard. This is taken as evidence for the assumption that a channeled particle does not contribute to sputtering. On the basis of the assumption that the sputtering ratio is proportional to the energy dissipation of the non-channeled part of the beam within a layer x_0, a two-parameter expression for the sputtering ratio has been obtained. Calculations have been performed for normally incident Ar^+, Kr^+, and Cu^+ ions on (111), (110), and (100) Cu crystals in the energy range 2 to 40 keV. The best fit has been obtained for x_0 values of the order of 80 Å. From the description of Ar^+ on (100) Au, x_0 is about 135 Å. This is thought to be due to the influence of the focusing collision chain length on the thickness of the layer important for sputtering. Furthermore, it is shown that a satisfactory description of the angular behavior of the sputtering ratio can be obtained with the proposed model. (auth)

26232 SOME REGULARITIES OF ION-BEAM INTERACTIONS WITH SEMICONDUCTORS. Mashkova, E. S.; Molchanov, V. A. (Moscow State Univ.). Can. J. Phys., 46: 713-17(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

During the last few years, various regularities of ion interaction with crystals have been studied, and a number of effects caused by the regular arrangement of the target atoms have become apparent. A suitable interpretation of the observed crystal lattice effects can be produced on the basis of the perfect crystal. The success of the concept of the ideal crystal is determined by the fact that the conditions of many experiments permit rapid annealing of the defects caused by the ion bombardment. In order to prove this assumption, it was necessary to make measurements over a wide temperature range, including the annealing temperature. Germanium and silicon monocrystalline targets were chosen. The targets were bombarded by 30-keV ions of the noble gases. The temperature range studied was from about 100 to 700°C. The influence of temperature on the angular regularities of the secondary electron-emission coefficient and on the energy distributions of the scattered ions was investigated. Two strongly different types of ion–electron emission and of scattering regularities were established. At comparatively high temperatures, there are typical anisotropies of the secondary electron-emission coefficient and the "double"-scattering peaks in energy distributions, caused by regular arrangement of the target atoms. At lower temperatures, the normal polycrystalline dependences are observed, i.e., the secondary electron coefficient increases monotonically with increasing incident angle, and the "double"-scattering peak is smoothed out. It has been established that the dependences usually observed with polycrystals change sharply to those observed with single crystals within a small temperature range around the defect-annealing temperature. Thus, the concept of the ideal crystal may be used for interpreting the results of ion interactions with crystals, provided the measurements are made at temperatures higher than the annealing temperature of the defects. (auth)

26233 CHARGE EXCHANGE OF 5- TO 40-keV PROTONS IN THICK VAPOR JETS OF LITHIUM, SODIUM, MAGNESIUM, AND ZINC. D'yachkov, B. A.; Zinenko, V. I. At. Energ. (USSR), 24: 18-20(Jan. 1968). (In Russian).

The conversion coefficients of protons with energy from 5 to 40 keV in neutral atoms and negative ions in lithium jets as well as in jets of sodium, magnesium, and zinc were measured. The indicated measurements represented interest for the techniques of obtaining intense beams of neutral and negative ions. The density of the jets was determined by the heat evolved during condensation of the jet material and by the mean velocity of the current. The maximum density of the lithium jet was equal to 10^{16} atom/cm^3. The measurements were made by the mass spectrometric method. The precision of the measurements of the conversion coefficients was ±5%, and the thickness of the jets were ~10% on the lower side. The yield of the negative ions in the lithium and sodium jets rapidly decreased with increase of the energy and at 20 keV was only 0.2%, whereas for zinc at the same energy the yield was 2.5%. The results obtained confirm the conclusion that the conversion coefficients of positive ions of hydrogen to negative in the vapor of some metals (zinc, magnesium) is substantially higher than in gaseous targets. (tr-auth)

26234 THEORY OF NEUTRALIZATION OF AN ISOLATED ION PAIR; APPLICATION TO THE METHOD OF PRESCRIBED DIFFUSION TO RANDOM WALK IN A COULOMB FIELD. Mozumder, A. (Univ. of Notre Dame, Ind.). J. Chem. Phys., 48: 1659-65(Feb. 15, 1968). (COO-38-572).

The problem of random walk of an ion pair in their mutual Coulomb field is formulated here in the framework of "prescribed diffusion." The solution of this problem, when integrated over volume, given the probability that the ion pair will remain unneutralized at a given time. In the limit $t \to \infty$, this probability calculated by the present method gives exactly the same expression as the Onsager formula. Half-life for neutralization is computed and its variation is studied with time, temperature, and thermalization length. The case of an entire track is also discussed and possible application to neutralization of changes produced by ionizing radiations is indicated. (auth)

26235 CHECKS FOR THE HYPERFINE-STRUCTURE MATRICES IN AN ATOMIC CONFIGURATION. Bauche-Arnoult, Cl.; Bauche, J. (Centre National de la Recherche Scientifique, Orsay, France). J. Opt. Soc. Amer., 58: 704-5(May 1968).

Methods of checking the matrices for almost all practical cases of electrostatic and spin–orbit interactions in an atomic configuration have been given by Racah (Bull. Res. Council Israel, F8: 1 (1959)). Other methods are reported here which can be used to verify the corresponding matrices of hfs parameters. (auth)

26236 ASYMPTOTIC EXPANSIONS OF THE INTEGRATED ABSORPTANCE FOR SIMPLE SPECTRAL LINES AND LINES WITH HYPERFINE STRUCTURE AND ISOTOPE SHIFTS. van Trigt, C. (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). J. Opt. Soc. Amer., 58: 669-78(May 1968).

Asymptotic expansions of the integrated absorptance for weak and strong lines are given for both simple spectral lines and lines with hyperfine structure and isotope shifts. The separation and relative intensities of the different lines as determined by quantum mechanics are taken into account. The lines are assumed to have a Voigt profile. (auth)

26237 BEAM-FOIL EXCITATION OF MULTIPLY IONIZED NITROGEN. Fink, Uwe; McIntire, G. N.; Bashkin, S. (Univ. of Arizona, Tucson). J. Opt. Soc. Amer., 58: 475-9(Apr. 1968).

A detailed study is presented of the electronic excitation of a ni-

trogen beam accelerated by a Van de Graaff machine to energies between 0.25 and 2.0 MeV/atom, and passed through a thin carbon target foil. About 100 spectral lines of NII through NV were detected. In addition, a number of unidentified lines were seen and their wavelengths measured. Decay times of 27 levels in NII through NV were measured and correlated with calculated transition probabilities. (auth)

26238 CALCULATION OF THE MOMENTUM TRANSFER CROSS SECTION OF ELECTRON–ATOM COLLISIONS IN CESIUM VAPOR FROM DRIFT VELOCITY MEASUREMENTS. Postma, A. J. (EURATOM–FOM, Jutphaas, Netherland). Phys. Lett., 26A: 492-3(Apr. 8, 1968).

The electron energy distribution in a cesium discharge is calculated, taking into account elastic and inelastic collisions. Electron drift velocities derived from it are compared with experimental ones. This gives information about the electron–atom momentum transfer cross section. (auth)

26239 IONIZATION OF HYDROGEN BY ELECTRON IMPACT AT 250 TO 2200 eV. Fiquet-Fayard, Florence; Chiari, J. (Faculte des Sciences, Orsay, France). Phys. Lett., 26A: 512-13(Apr. 8, 1968).

D^+ ions are formed in a process with simultaneous ionization and excitation. The abundance of these D^+ ions is about 1% of the parent. The cross section for this process shows an E^{-1} dependence. (auth)

26240 $N^+ + O^-$ NEUTRALIZATION CROSS-SECTION MEASUREMENTS USING A SUPERIMPOSED-BEAM TECHNIQUE. Aberth, W.; Peterson, J. R.; Lorents, D. C.; Cook, C. J. (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev. Lett., 20: 979-81(Apr. 29, 1968).

The two-body $N^+ + O^-$ neutralization cross section was measured via a superimposed-beam technique. The energy range in the barycentric coordinate system is 0.1-86 eV with about 0.1-eV resolution. The measured value of the neutralization cross section, Q, times the relative speed, v, is approximately constant (9×10^{-8} cm^3/sec), except below 0.5 eV, where Qv increases rapidly with decreasing energy. (auth)

26241 NUCLEAR SPIN RELAXATION IN POLYATOMIC GASES: A NEW EFFECT. Dong, Ronald Y.; Bloom, Myer (Univ. of British Columbia, Vancouver). Phys. Rev. Lett., 20: 981-3(Apr. 29, 1968).

A very striking density dependence of the proton spin–lattice relaxation time in gaseous fluoroform (CHF_3) and methyl fluoride (CH_3F) was observed. Measurements of the type reported should be useful in the determination of anisotropic intermolecular potentials for symmetric-top molecules. A plot is given of the proton spin–lattice relaxation time to density ratio for CHF_3 gas. (J.F.P.)

26242 PHOTOCONDUCTIVITY OF EuS AND EuSe. Bachmann, R.; Wachter, P. (Eidgenoessische Technische Hochschule, Zurich). Phys. Lett., 26A: 478-9(Apr. 8, 1968).

The photoconductivity of EuS and EuSe was measured. The activation energy of the photoconduction coincides with the optical absorption edge. The results indicate that an electronic transition into a conduction band occurs. Photoconduction was also observed in EuO. (auth)

26243 THORIUM LAMPS AND INTERFEROMETRICALLY MEASURED THORIUM WAVELENGTHS. Valero, Francisco P. J. (Univ. Nacional de La Plata, Argentina. Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires). J. Opt. Soc. Amer., 58: 484-9(Apr. 1968).

Wavelengths emitted from an electrodeless thorium iodide lamp are compared with those emitted by water-cooled and liquid-nitrogen-cooled hollow-cathode lamps. Three hundred forty-six thorium lines have been interferometrically measured, using a hollow-cathode lamp as a source, in the range from 4574 to 6676 Å. The accuracy of the measurements has been tested using the combination principle, and was found to be one part in 6 to 9.5×10^7. (auth)

26244 X-RAY SATELLITE INTENSITIES IN THE SUDDEN APPROXIMATION. Aberg, T. (Univ. of Helsinki). Phys. Lett., 26A: 515-16(Apr. 8, 1968).

The relative intensities of the $K\alpha_1\alpha_2$ satellite group $\alpha'\alpha_3\alpha_4$ are calculated for neon-like ions ($9 \leq Z \leq 20$), and compared with experimental intensities resulting from both electron and x-ray excitation. (auth)

26245 ENHANCEMENT OF NEUTRAL–NEUTRAL IONIZATION PROCESSES BY INTERNAL EXCITATION ENERGY IN THE COLLIDING PARTICLES. Utterback, Nyle G.; Van Zyl, Bert (General Motors Corp., Santa Barbara, Calif.). Contract DA-01-021-AMC-11359(Z). Phys. Rev. Lett., 20: 1021–4(May 6, 1968).

The ionization cross section for collisions of a neutral beam of excited nitrogen molecules with argon was measured over the center-of-mass kinetic energy range 12 to 120 eV and was compared with the ionization cross section measured with a ground-state nitrogen molecular beam. The cross section for excited molecules was found to be 50 times that for ground-state molecules at 2 eV above the ionization-energy threshold involving ground-state molecules. The secondary-electron or negative-ion emission coefficient was also measured for the excited nitrogen molecules on a dirty gold surface. It was found to decrease rapidly with decreasing kinetic energy down to 25 eV (lab), but then appeared to approach 1×10^{-4} at the lower energies. The coefficient for ground-state molecules continued to decrease rapidly toward zero with decreasing kinetic energy below 25 eV. (A.G.W.)

26246 AN IMPROVEMENT OF THE BORN APPROXIMATION METHOD IN SCATTERING THEORY. Ronveaux, Andre (Univ. de Montreal, Paris). Compt. Rend., Ser. A and B, 266: 172-4 (Jan. 15, 1968). (In French).

The first Born approximation in the scattering theory is systematically improved for the finite input potentials. The results indicate in which case the first Born approximation is a superior or inferior terminal and not only an approximation. (tr-auth)

26247 FIFTH SPECTRUM OF PRASEODYMIUM. Kaufman, Victor; Sugar, Jack (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand., A, 71: 583-5(Nov.-Dec. 1967).

Twelve spectral lines of quadruply ionized praseodymium in the region 840 to 2250 Å are reported. Five terms ($4f\ ^2F$, $5d\ ^2D$, $6s\ ^2S$, $6p\ ^2P$, and $7s\ ^2S$) and the hyperfine splitting of the $6s\ ^2S$ term are given. A calculation of the principal ionization energy ($Pr^{4+} \rightarrow Pr^{5+}$) leads to a value of 57.44 eV with an estimated uncertainty of ±0.05 eV. (auth)

26248 AN IMPROVED DESCRIPTION OF TECHNETIUM SPECTRA (Tc I AND Tc II), 2000 TO 9000 A. Bozman, W. R.; Meggers, W. F.; Corliss, C. H. (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand., A, 71: 547-65 (Nov.-Dec. 1967).

A new description of technetium spectra has been made that is more complete and provides more accurate data on wavelengths than those reported heretofore. The observations were made in the region 2000 to 9000 Å with arc and spark sources. Larger samples of technetium and spectrographs of higher resolution were used and the number of lines reported (4500) is more than doubled. The intensities are estimated over a range from 1 to 20,000 and the relative strengths in arc and spark permit assignment of the origin of the lines to neutral atoms (3300 lines) or ions (1200 lines). (auth)

26249 FUNDAMENTAL ENERGY LEVELS OF NEUTRAL PROMETHIUM (Pm I). Reader, Joseph; Davis, Sumner P. (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand., A, 71: 587-99(Nov.-Dec. 1967).

The spectrum of atomic promethium has been observed with a variety of light sources and spectrographs. The Zeeman effect has also been recorded. Analysis of the spectrum shows that the ground configuration of the neutral promethium atom is $4f^56s^2$. The relative positions (in cm^{-1}) of the low levels of this configuration are given. This group represents all levels of $4f^56s^2$ expected below 14,000 cm^{-1}. From these results the following values of interaction parameters and their estimated uncertainties have been inferred: $\zeta_{4f} = 925 \pm 20$ cm^{-1}, $E^3 = 510 \pm 20$ cm^{-1}. Data on 209 upper levels of even parity and 714 classified lines are given. (auth)

26250 THE SECOND SPECTRUM OF YTTERBIUM (Yb II). Meggers, William F. J. Res. Nat. Bur. Stand., A, 71: 396-546(Nov.-Dec. 1967).

The analysis of Yb II provides the most complete interpretation of a complex rare-earth spectrum known to date. The total number of energy levels is 315; 141 even levels and 174 odd levels. Three coupling schemes are represented: LS-coupling for the terms $4f^{14}$ ns ^2S(n = 6, 7, 8); $4f^{14}$ nd ^2D(n = 5, 6, 7)and $4f^{12}6s^2\ ^2F^o$; J_1J_{II}-coupling for the levels from the configurations $4\ f^{13}$ 6s 6p and $4f^{13}$ 5d 6p; and J_1L_{II}-coupling for those from the $4f^{13}$ 5d 6s and $4f^{13}$ $5d^2$ configurations. More than 5000 Yb II lines are listed, of which about 80% have been classified, and 95% of the total intensity is accounted for. Observed Zeeman patterns for over 1000 lines have yielded g values for 258 levels. The agreement between observation and theory is excellent as regards both the positions of the energy levels and the g values. The theoretical work was done in collaboration with Racah and his associates over more than a decade. A limit, 98150 K, giving an ionization potential of 12.17 eV, has been derived from the three-member ^2S series. (auth)

26251 CAPTURE RADIUS FOR ION RECOMBINATION. Parks, Eric K. (Univ. of California, Berkeley). J. Chem. Phys., 48: 1483-7(Feb. 15, 1968). (UCRL-17754).

An expression for the capture radius defined by Thomson for three-body ion recombination is derived for arbitrary ion and neutral masses. The recombination rate constants calculated from this expression for a variety of systems are compared with the available experimental data. It is found that use of the rigorously calculated capture radius seriously underestimates the recombination rate constant. (auth)

26252 CALCULATION OF ELECTRON SHAKE-OFF FOR ELEMENTS FROM Z = 2 TO 92 WITH THE USE OF SELF-CONSISTENT-FIELD WAVE FUNCTIONS. Carlson, Thomas A. (Oak Ridge National Lab., Tenn.); Nestor, C. W. Jr.; Tucker, Thomas C.; Malik, F. B. Phys. Rev., 169: 27-36(May 5, 1968). (ORNL-P-3612).

Calculations of electron shake-off, based on the sudden approximation, have been made for several different processes. In particular, electron shake-off as the result of β decay has been computed for each of the shells in 15 different cases from an initial Z = 2 to 92. An interpolation of the results has been made for the remaining elements. Calculations were made with nonrelativistic Hartree–Fock wave functions for the lighter elements, and relativistic Hartree–Fock–Slater wave functions for the heavier ones. A comparison is made with available experimental data, and satisfactory agreement is obtained. Other ionization processes amenable to the use of the sudden approximation are also discussed, viz., β^+ decay, Auger processes, photo-ionization, internal conversion, electron capture, and inner-shell ionization by electron impact. (auth)

26253 TRANSPORT COEFFICIENTS AND ENERGY DISTRIBUTIONS OF ELECTRONS IN GASES. Bell, M. J.; Kostin, M. D. (Princeton Univ., N. J.). Phys. Rev., 169: 150-5(May 5, 1968).

The steady-state energy distribution of free electrons in a gas subjected to a constant electric field has been simulated stochastically. The effects of the thermal motion of the gas molecules, inelastic collisions, and the energy dependence of the collision cross sections have been included. Under appropriate limiting conditions, the stochastically generated results reduce to the analytical results of Maxwell, Davydov, and Druyvestian. Use of this technique, along with values of cross sections reported in the literature, has made possible the calculation of the drift velocities and diffusion coefficients of electrons in helium, hydrogen, and nitrogen as a function of the ratio E/P. The calculated results agree well with experimental values given in the literature over a range of E/P from 0.002 to 0.20 V/cm mm Hg. (auth)

26254 COUPLED-STATE CALCULATIONS OF PROTON–HYDROGEN SCATTERING IN THE STURMIAN REPRESENTATION. Gallaher, D. F.; Wilets, L. (Univ. of Washington, Seattle). Contract AT(45-1)-1388B. Phys. Rev., 169: 139-49 (May 5, 1968). (RLO-1388-521).

Proton–hydrogen scattering has been solved in the Sturmian representation. The Sturmian functions of Rotenberg form an infinite, discrete, and complete basis set without a continuum. Comparison has been made with the following proton–hydrogen scattering experiments: transfer and excitation cross sections to the 2s and 2p states, the total exchange cross section, and the notable experiments of Helbig and Everhart on the total transfer probability at 3°. Particularly excellent agreement is found with the last. This work is a direct extension of previous calculations for the proton–hydrogen scattering problem developed by the authors in which the expansion basis functions were discrete, traveling hydrogenic states. The present work demonstrates the role of the hydrogenic continuum. (auth)

26255 EIKONAL METHOD IN ATOMIC COLLISIONS. I. Wilets, L.; Wallace, S. J. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Phys. Rev., 169: 84-91(May 5, 1968).

A complete and systematic quantal description of atomic collisions is developed employing the eikonal method. The lowest-order approximation involves the solution of the time-dependent Schrödinger equation for the electrons in the rectilinear trajectories of the atomic nuclei. The differential scattering amplitude (and hence the differential cross section) for the various reaction channels is expressed as a Fraunhofer integral, over the impact parameter, of the asymptotic state amplitudes. This completely avoids the ambiguities involved in obtaining an effective interatomic potential. Higher-order corrections are exhibited. However, the lowest-order approximation not only is valid at high energies, but penetrates deeply into the adiabatic regime, probably down to 100 eV. Numerical calculations will be presented in a later paper. (auth)

26256 ENERGY SPECTRA OF AUTO-IONIZING ELECTRONS IN OXYGEN. Rudd, M. E.; Smith, Kenneth (Univ. of Nebraska, Lincoln). Phys. Rev., 169: 79-84(May 5, 1968).

Experimental and theoretical data are presented showing the energy spectra of auto-ionizing electrons from atomic oxygen. The experimental data were obtained by bombarding oxygen gas with 100-keV H^+ and He^+ ions; the theoretical results were obtained in a close-coupling calculation that coupled the ^4S, ^2D, and ^2P terms of the ground-state configuration of O^+ in electron–O^+ scattering. (auth)

26257 EXPERIMENTS ON THE 2^3P STATE OF HELIUM. I. A MEASUREMENT OF THE 2^3P_1–2^3P_2 FINE STRUCTURE. Pichanick, F. M. J.; Swift, R. D.; Johnson, C. E.; Hughes, V. W. (Yale Univ., New Haven). Phys. Rev., 169: 55-78(May 5, 1968).

A measurement, accurate to 3 ppM, is reported of the 2^3P_1–2^3P_2 fine structure in He^4. An atomic-beam optical-microwave resonance technique was used. Two sets of measurements were made on the transition $2^3P_1(m_j = 0) \rightleftharpoons 2^3P_2(m_j = 0)$. The first set was in a magnetic field of about 100 G("low" field), where the uncertainties arose from field-dependent asymmetries in the line shape. The second set of measurements was in a field of about 500 G ("high" field), and here the main uncertainties were in the field measurements and the calculation of g factors. The results of the two sets were in good agreement, low field: $E(2^3P_1) - E(2^3P_2) = 2291.188 \pm 0.015$ MHz; high field: $E(2^3P_1) - E(2^3P_2) = 2291.197 \pm 0.008$ MHz; weighted mean: $E(2^3P_1) - E(2^3P_2) = 2291.195 \pm 0.007$ MHz. The advantages of the atomic-beam technique and the possible importance of this fine-structure measurement are discussed. (auth)

26258 USE OF ELECTRON SCATTERING DATA TO OBTAIN ACCURATE BORN CROSS SECTIONS FOR ATOM–ATOM AND OTHER HEAVY-PARTICLE COLLISIONS. II. BREAKUP OF FAST H_2^+ UPON COLLISION WITH He. Green, Thomas A.; Peek, James M. (Sandia Corp., Albuquerque, N. Mex.). Phys. Rev., 169: 37-47(May 5, 1968).

In an earlier paper it was suggested that, in Born calculations of total cross sections for heavy-particle collisions, it might be more practical, if accuracies of the order of 10% are acceptable, to obtain the necessary matrix elements by measuring differential electron–atom and electron–molecule cross sections than it would be to calculate the matrix elements from the wave functions of the initial and final atomic or molecular states. In this paper the foregoing idea is explored for H_2^+–He collisions. Experimental electron cross sections are used only for He; theoretical ones are used for H_2^+. Since Lassettre's electron–He measurements do not extend to large enough momentum transfers to allow calculation of the H_2^+–He total cross sections for all transitions of interest, theory is introduced to provide quantitative extrapolations of the experimental data to larger momentum transfers. By this means the extent to which the H_2^+–He total cross sections are determined by the unextrapolated electron–He measurements is examined. At the same time, ranges of momentum transfer are determined, over which the electron–He cross sections need to be measured if they are to be adequate for H_2^+–He total cross-section calculations, without the use of quantitative extrapolation. By a generalization of the H_2^+–He results, analogous ranges are determined for the electron–scattering measurements relevant to most heavy-particle collisions of practical interest. The general results show that the most extensive of Lassettre's electron excitation measurements are adequate for heavy-particle collisions in which both collision partners undergo transitions to discrete excited states. Measurements of electron cross sections out to larger momentum transfers than this are required, however, for other combinations of the possible final states of the colliding particles. A table of the upper limits of the required ranges of momentum transfers is given in the hope that it may stimulate additional experimental work. Of particular importance is the measurement of differential electron ionization cross sections out to large values of momentum transfer and energy loss. From the H_2^+–He cross sections, theoretical cross sections are obtained for the breakup of H_2^+ via electronic excitation during collisions with He. These are compared with experiment. (auth)

26259 PHOTO-IONIZATION CROSS SECTION OF BERYLLIUM NEAR THRESHOLD. Altick, P. L. (Univ. of Nevada, Reno). Phys. Rev., 169: 21-6(May 5, 1968).

The ^1P continuum wave functions of beryllium with energies from 0 to ~3.5 eV above the 2s threshold are calculated with the inclusion of auto-ionizing lines by configuration interaction. These functions are then combined with a ten-configuration ground-state function to compute the photo-ionization cross section, which is found to be dominated by auto-ionization from the 2pns and the 2pnd series. The energy region studied contains the first three 2pns lines, which have widths of a significant fraction of a volt, comparable to their separation; and the first two 2pnd lines, which are about a thousand times narrower. There are no experimental measurements of the cross section for comparison;

however, the computed phase shift agrees reasonably well with recent close-coupling calculations. (auth)

26260 HYPERFINE EFFECTS IN MUONIC Bi AND Pb. Powers, R. J. (Univ. of Chicago). Phys. Rev., 169: 1-20 (May 5, 1968).

The K and L transitions in the muonic spectra of ^{209}Bi and of the separated isotopes ^{206}Pb, ^{207}Pb, and ^{208}Pb were investigated, using a Ge(Li) spectrometer. The isotope shifts in Pb, in excellent agreement with the optical data, are half those predicted by the $A^{\frac{1}{3}}$ law. The agreement between shifts and the optical shifts strongly suggests the absence of nuclear polarization by the muon. The M1 and E2 hyperfine (hf) interactions in ^{209}Bi were studied. The M1 results, although not sensitive enough to distinguish models of nuclear magnetization distributions, rule out a point magnetic dipole. The E2 constants, when used in conjunction with the measured isotope shift between ^{209}Bi and ^{208}Pb, suggest a quadrupole distribution produced by an $h_{\frac{9}{2}}$ proton and a slightly (~1%) deformed ^{208}Pb core. The effects of E3 mixing of ^{209}Bi nuclear levels on the K and L intensity ratios and on the interpretation of the hf constants were examined. (auth)

26261 SEMICLASSICAL TREATMENT OF MULTIPLE TURNING-POINT PROBLEMS: PHASE SHIFTS AND EIGENVALUES. Miller, William H. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 48: 1651-8(Feb. 15, 1968).

A simple, physically intuitive, expression has been obtained for the scattering phase shift $\delta(l, E)$ in the case that the effective radial potential possesses a maximum. The result is seen to modify the usual WKB phase shift by replacing a step function by a particular "smooth step function." On the basis of this result, resonances in the energy dependence of the total elastic cross section are discussed. From qualitative arguments it is seen that metastable states more than $\sim 0.6\ \hbar\omega_b$ energy units above the top of the barrier are too short-lived to have physical significance (ω_b is the harmonic frequency related to the inverted barrier). Application is also made to the eigenvalues of a hindered rotor. (auth)

26262 CONDENSED-STATE EFFECTS IN MUONIC X-RAY SPECTRA. Daniel, H.; Koch, H.; Poelz, G.; Schmitt, H.; Tauscher, L.; Backenstoss, G.; Charalambus, S. (CERN, Geneva. Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Karlsruhe, Ger.). Phys. Lett., 26B: 281-2(Feb. 5, 1968).

Intensity measurements of muonic x rays in targets of different physical or chemical composition are reported. (auth)

26263 EFFECT OF BOND FORMATION ON ELECTRON SCATTERING CROSS SECTIONS FOR MOLECULES. Kohl, Denis Alan. Bloomington, Ind., Indiana Univ., 1967. 94p.

Thesis.

Since accurate molecular wavefunctions are not available, theoretical expressions for the electron scattering cross sections for molecules only formally include the effect of bond formation. Tavard and coworkers have shown that the effect is a general decrease in the scattered intensity at small scattering angles. If the scattering process is interpreted in terms of the first Born approximation, they also showed that the decrease in intensity as a function of scattering angle is quantitatively related to a number of molecular properties including the binding energy, the three-dimensional electron density and the radially symmetric part of the electron–electron density. Total differential scattering cross sections were obtained experimentally for molecular hydrogen, nitrogen and oxygen. The cross section for helium was also measured and compared with a calculated cross section to calibrate the apparatus. The calculation of the binding energy from the data is straightforward however the binding energy is an indirect measurement and is very sensitive to experimental errors and to deviations from the Born approximation scattering theory. The scattering method is not comparable in accuracy to other methods for obtaining the binding energy itself but it is useful as a test of scattering theory. The binding energies which were obtained for nitrogen and oxygen were considerably higher than the accepted values. The experimental uncertainties were quite large but the results suggest that there may be significant deviations from the simple theory. The information about the molecular densities is potentially the most valuable result obtainable from this type of experiment. The data were not sufficiently accurate and numerical methods have not been developed to a point where quantitative calculations of the electron densities could be made. Qualitative arguments indicate the observed intensities are consistent with what is known about the effect of binding on molecules. The theoretical helium scattering cross section used to calibrate the apparatus was calculated with a correlated wavefunction which was the result of a study of wavefunctions of simple form for helium like atoms. Quite good energies were obtained for the number of terms involved in the wavefunction and the Born approximation scattering factors could be calculated analytically for the type of wavefunction which was used. The design of the electron diffraction apparatus used to obtain the scattering cross sections follows the general design of similar units. It is described briefly with the emphasis on the unique features. The scattering patterns are recorded on photographic plates and the last two chapters are related to the use of photographic plates. An automatic, high precision microphotometer was constructed which can measure optical density with an uncertainty of a few parts per ten thousand. The microphotometer and the sources of uncertainty in the measurement of optical density are discussed in detail. For exposure to light the sensitivity of the type of plates which were used was known to vary with the position on the plate. Tests were conducted and the same behavior was observed for exposure to electrons. However, from the information obtained neither the cause nor a calibration could be determined. (Diss. Abstr.)

26264 SPIN-EXCHANGE CROSS SECTIONS OF ALKALI ATOMS. Chang, Chen-kun. Houston, Tex., Univ. of Houston, 1967. 142p.

Thesis.

To calculate numerically spin-exchange cross sections, the spin-dependent interaction characterizing the scattering is required. This interaction for two alkaline atoms is calculated by individually considering the interactions due to the valence S electrons and to the closed electronic shells of the two atoms. The two-S-electron interaction is generated phenomenologically from the known hydrogen–hydrogen interatomic potential and the closed-shell interaction from interatomic potentials of two inert atoms. Two undetermined parameters characterizing the scale of the interaction are introduced in this generation. These parameters are determined from experimentally known values of the equilibrium distance and the dissociation energy appropriate for the molecular state of the atomic system of interest. These theoretical potentials so obtained are in agreement with those constructed from band spectra. Unfortunately, these direct observations yield spin-dependent interaction potentials only for the singlet state of the alkaline atoms. This technique is extended to obtain the interaction potentials for cases for which there is at the present time inadequate experimental information for their construction, and for those cases in which no stable molecule is formed. It is hoped that the good agreement of our phenomenological calculation of potentials can be extrapolated to those cases for which no experimental check is possible. These interaction potentials are also used to calculate the second virial coefficients. The present theories of spin-dependent scattering of alkali-like atoms are introduced, and our potentials are used to calculate various cross sections by semi-classical techniques and by partial wave analysis. The results of the semi-classical method compare fairly well with experimental ones. Six different scattering cross sections are calculated by partial wave analysis for each of the six alkaline atoms, H, Li, Na, K, Rb and Cs, for 124 different relative kinetic energies. These cross sections are finally averaged with Maxwellian distribution for temperature of range from 10 to 9500°K. Comparing the spin-exchange cross sections calculated by the two methods shows that the cross sections calculated by semi-classical methods are too small by about 10% for the heavier atoms at the higher energies, and by about 50% for the light atoms at low energies. (Disser. Abstr.)

26265 ELECTRON DESORPTION OF ACTIVE GASES FROM TUNGSTEN. Sandstrom, Donald Richard. Pullman, Wash., Washington State Univ., 1967. 68p.

Thesis.

Ions released by electron-impact from a layer of carbon monoxide adsorbed on the (211) face of tungsten were shown to be O^+ by a direct mass spectrometric technique. No CO^+ ions were observed. It was observed that O^+ ions were released from each of two surface states, the α phase of carbon monoxide and an oxygen impurity layer produced by electron-impact induced dissociation of carbon monoxide. A mathematical model is presented describing the kinetics of desorption via dissociation. The total electron-impact desorption cross section for the α phase of carbon monoxide was found to be $2.8 \pm 0.3 \times 10^{-18}$ cm^2, and that from the oxygen layer $1.0 \pm 0.3 \times 10^{-18}$ cm^2. Agreement is obtained with the Roberts–Miller theory for the adsorption into the α phase of carbon monoxide for relative surface coverages less than 0.8, and reasons for the deviation above this figure are proposed. (Disser. Abstr.)

26266 PROCEEDINGS OF AN INTERNATIONAL CONFERENCE ON ATOMIC COLLISIONS AND PENETRATION STUDIES WITH ENERGETIC (keV) ION BEAMS, CHALK RIVER, ONTARIO, SEPTEMBER 18–21, 1967. Can. J. Phys., 46: 449-782(Mar. 15, 1968). (CONF-670966).

Separate abstracts were prepared for thirty-nine of the forty

papers included. One paper was previously abstracted in NSA 22: 21870. (A.G.W.)

For abstracts of individual papers see: 26219–26232, and 26471–26495.

Cosmic Radiation

Refer also to abstracts 26119, 26148, and 26155.

26267 (AECL-3064) COSMIC-RAY NM-64 NEUTRON MONITOR DATA. VIII. Monthly Graphs, September–December 1967. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1968. 70p. Dep. CFSTI. CAN.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada (Deep River, Alert, Goose Bay, and Inuvik) using equipment maintained by AECL are given in tabular form for the period from Sept. to Dec. 1967. Normalized graphs are given for the period Sept. to Dec. 1967. A warning about defective barometer vacuum at two stations is included. (auth)

26268 (RAE-TR-67206) ESTIMATE OF CORPUSCULAR RADIATION DOSE RATES FOR TYPICAL BLACK ARROW SATELLITES. Savage, C. J. (Royal Aircraft Establishment, Farnborough (England)). Aug. 1967. 20p. Dep.

Radiation dose rates for components positioned on the outer surface or within a Black Arrow type satellite were estimated. Attention was restricted to circular polar orbits in the altitude range 500 to 1900 km and to the 36,000-km synchronous orbit. (auth) (UK)

26269 FLUX OF COSMIC-RAY ELECTRONS BETWEEN 17 AND 63 MeV. Israel, Martin H.; Vogt, Rochus E. (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 20: 1053-6(May 6, 1968).

The flux of cosmic-ray electrons in the energy interval of 17 to 63 MeV was measured in three high-altitude balloon flights during the summer 1967 near Fort Churchill, Manitoba. The average flux was found to be 0.3 ± 0.2 electrons/m^2 sec sterad MeV. Implications of this result on models of the origin of galactic cosmic-ray electrons and their solar modulation are discussed. (auth)

Direct Energy Conversion

Refer also to abstracts 26289 and 26290.

26270 (ANL-7375, pp 160-75) ENERGY CONVERSION. (Argonne National Lab., Ill.).

Thermally regenerative galvanic cells continue to be of interest as devices for the direct conversion of thermal energy, as from radioactive isotopes or a nuclear reactor, into electrical energy and for the storage of electrical energy. The principal potential advantages of galvanic cell systems are (1) their compactness (high power output per unit weight and volume), (2) the elimination of moving parts, and (3) a long maintenance-free life. In addition, it has been found that certain bimetallic cells are well-suited to the purpose of energy storage because they can serve as high-rate secondary cells, thus enhancing the utility of the energy depot concept. It is not reasonable to expect that the broad range of potential applications for galvanic cells with fused-salt electrolytes can be served by only one or two types of cells; hence, a broad-based research activity has supported all of the cell work. The results obtained thus far indicate that lithium and sodium can serve as anode materials for a rather wide range of operating conditions and applications. The sodium anode cells would be preferred for those applications where relatively low regeneration temperatures (700 to 1000°C) are available, whereas lithium anode cells are particularly suitable when higher regeneration temperatures (1000 to 1300°C) are available. In addition, the lithium anode cells are very attractive as light-weight, high-power-density secondary cells, capable of operation at relatively low temperatures (down to 340°C). (TSS)

26271 (GESR-2109) SIMCON: A DIGITAL COMPUTER PROGRAM FOR COMPUTING THERMIONIC CONVERTER PERFORMANCE CHARACTERISTICS. Wilkins, D. R. (General Electric Co., Pleasanton, Calif. Nuclear Thermionic Power Operation). Feb. 1, 1968. Contract AT(04-3)-189. 82p. Dep. CFSTI.

The theoretical foundation and use of a digital computer program (SIMCON) for computing thermionic converter performance characteristics are described. The analyses and program simultaneously account for the influence of surface phenomena, volume phenomena, and Schottky effects on converter operation and yield output current characteristics which are in good agreement with experimental data for a very broad range of converter operating conditions. (M.H.R.)

26272 RELAXATION EFFECTS IN J x B DEVICES. Lackner, K.; Argyropoulos, G. S.; Demetriades, S. T. (STD Research Corp., Pasadena, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 949-51(May 1968).

The influence of relaxation or convective effects on the current distribution in nonequilibrium J × B devices with finitely segmented electrodes has been considered previously. Different, and contradictory, assumptions were employed concerning the nature and magnitude of the dominant relaxation effect in seeded plasmas. Here, the validity of each of these assumptions is discussed by making use of two consistently defined relaxation lengths for the three-body recombination reaction, and for the electron energy relaxation, respectively. (M.H.R.)

26273 ELECTRODE-SIZE EFFECTS IN AN MHD GENERATOR WITH NONUNIFORM ELECTRICAL CONDUCTION. MacDonald, J. R. (Stanford Univ., Calif.); Mitchner, M.; Oliver, D. A. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 948-9 (May 1968).

The methods formulated by Oliver and Mitchner (AIAA Journal, 5: 1424-32(1967)) are used to study the effect of electrode size on the performance of an MHD generator with nonuniform electrical conductivity. End effects are neglected. All properties are assumed to be periodic between channel sections. The gas is assumed to be electrically neutral, and the Hall parameter is assumed to be constant throughout the channel. The velocity is assumed to have a component only in the x direction and to vary only with y. The conductivity profiles considered are linear. (M.H.R.)

26274 EXPERIMENTAL INVESTIGATION OF THE CURRENT DENSITY DISTRIBUTION IN A SIMULATED MHD GENERATOR. Fischer, Fred W. (Institut fuer Plasmaphysik, GmbH, Garching, Ger.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 894-900 (May 1968).

In a magnetohydrodynamic generator with segmented electrodes, the Hall effect prevents a homogeneous current distribution in the region of the electrodes. The results of calculations of the current density distribution in an inert gas alkali metal plasma using simplifying assumptions were compared with measurements made in a simulated argon–potassium generator. The gas in the generator channel had a temperature of about 2000°K and a pressure of 1.1 atm. The potassium content was 0.22% by weight. The gas velocity did not exceed 130 m/sec and the magnetic-field strength was held below 4500 gauss. The emf was simulated by applying an electric field of about 15 V across each electrode pair. Measurements of the intensity distribution of the potassium resonance lines permitted conclusions to be drawn with respect to the distribution of electron temperature and thus current density. In general, qualitative agreement with theory was found. The most pronounced deviation from theory occurred near the electrodes, particularly along the insulator between electrodes. The potential distribution measured along the insulator wall was consistent with light-intensity measurements. (auth)

26275 INFLUENCE OF POTASSIUM SEEDING ON THERMODYNAMIC PROPERTIES OF COMBUSTION PRODUCTS OF NATURAL FUELS. Yungman, V. S.; Gurvich, L. V.; Rtishcheva, N. P. (Academy of Sciences, Moscow). pp 222-6 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

The thermodynamic properties and equilibrium composition of combustion products of methane and residual oil with ionizing seeds have been calculated in the ranges of temperatures and pressures of interest for MHD problems. The formation of condensed phases has been considered in the calculations. Some problems have been discussed concerning the influence of uncertainty of thermodynamic properties of gaseous potassium compounds (hydroxide, sulfate, and carbonate) and formation of condensed phases on the results of the calculations. (auth)

26276 ANALYSIS OF A LINEAR MAGNETOPLASMADYNAMIC GENERATOR WITH PLASMA HEAVY COMPONENT IN UNIFORM STATE. Lo Surdo, C. (CNEN, Frascati, Italy). Alta Freq., 36: 218E(774)-229E(785)(Aug. 1967).

The present status of the theory of a linear magnetoplasmadynamic channel is developed with the important limitation of uniform state (i.e. pressure and temperature) of the plasma heavy component. This assumption permits avoidance of the complicated analysis of the coupled mass and charge flow regimes. The electric conduction phenomena, i.e., the current and potential distributions in the channel flow, can thus be studied within the simple framework of a 2-fluid model. A nonequilibrium microscopic model of a noble gas seeded by alkali vapors is first treated. The

macroscopic model has the following additional features: the regime is completely steady; the phenomenological parameters σ and β/B (the Hall number per unit magnetic induction) are univalued functions of j^2 (under thermodynamic equipartition conditions, these functions become σ = const.; β/B = const.); the analysis is limited of a channel bounded by 2 electrode walls, the other walls being at infinite distance from each other. The velocity must be regarded as a given field, typically of laminar type. Boundary conditions and external relations are discussed for the asymptotic regime for 3 types of external load connection: the Faraday type connection, between opposite electrodes. The Hall type connection, and the mixed type connection. The Laplace equation of conformal mapping techniques, Fourier series expansion, and numerical methods is explored at length. The asymptotic problem with Faraday load in nonequilibrium conditions is treated by Fourier Series expansion and direct numerical procedures. (BBB)

26277 GENERAL EQUATIONS OF THE SLIDING MAGNETIC FIELD OF A MAGNETOHYDRODYNAMIC MACHINE. Michel, Kant (CNRS, Fontenay-aux-Roses, France). Compt. Rend., Ser. A and B, 266: 164-7(Jan. 15, 1968). (In French).

The equations of the principal magnetic field of an induction MHD machine are developed. The solution proposed takes into consideration both the limiting effects and the finite permeability of the magnetic circuit. (tr-auth)

Fluid Physics

Refer also to abstract 26276.

26278 (CLM-P-160) TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC TURBULENCE. Robinson, D. C. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Jan. 1968. 6p. Dep. CFSTI. UK.

For a system governed by a generalized Ohm's law, an arbitrary velocity field cannot independently maintain magnetic field fluctuations in a two-dimensional situation. (auth)

26279 (D-1-82-0699) HYDROMAGNETIC SURFACE WAVES IN A CONDUCTING LIQUID SURROUNDED BY A FLOWING GAS. Gerwin, Richard (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Jan. 1968. 51p.

The stability of the interface between a highly conducting liquid and a flowing, non-conducting gas is studied, supposing a magnetic field to be parallel to the interface. Arbitrary angles are allowed between magnetic field, flow direction, and wave vector. (auth)

26280 ASPECTS OF MAGNETOGASDYNAMIC FLOWS INVOLVING UPSTREAM INFLUENCE EFFECTS. Swan, George W. (Army Mathematics Research Center, Madison, Wis.). Z. Angew. Math. Phys., 19: 149-52(Jan. 25, 1968).

The steady two-dimensional flow of a fully ionized gas over a nonconducting wall of shape allowable by a linearized theory is considered. The solution of the Maxwell equations in the region of the walls is attempted. Some of the flow configurations involve magnetogasdynamic shock waves. (M.H.R.)

26281 SOLUTION FOR UNSTEADY MAGNETOHYDRODYNAMIC FLOW INCLUDING ION-SLIP EFFECTS. Switick, D. M.; Kennedy, Lawrence A. (State Univ. of New York, Buffalo). Z. Angew. Math. Phys., 19: 145-8(Jan. 25, 1968).

The effects which a transient pressure gradient has upon the magnetohydrodynamic flow in a parallel-plate channel are studied. The general form of Ohm's law is used which retains the ion-slip terms. (M.H.R.)

26282 RECIPROCAL RELATIONS IN NON-STEADY ONE-DIMENSIONAL GASDYNAMICS. Rogers, Colin (Univ. of Nottingham, Eng.). Z. Angew. Math. Phys., 19: 58-63(Jan. 25, 1968).

Reciprocal relations are constructed for non-steady one-dimensional inviscid gasdynamics, and more generally for the one-dimensional flow of an infinitely conducting gas in the presence of a transverse magnetic field. An immediate extension is made to cover $(\epsilon + 1)$-dimensional spherically symmetric flows. Essentially, the work deals with the inverse method of constructing new classes of solutions to the governing equations of gasdynamics (magnetogasdynamics) using the concept of reciprocality. The concern here is not with applying the results to initial or boundary value problems. (M.H.R.)

26283 EFFECTS OF COUPLE STRESSES IN FLUIDS ON HYDROMAGNETIC CHANNEL FLOWS. Stokes, Vijay Kumar (Indian Inst. of Tech., Kanpur). Phys. Fluids, 11: 1131-3(May 1968).

Two boundary value problems have been solved. It has been shown that for large Hartmann numbers the effects of couple stresses are quite large for Poiseuille flow between two parallel plates subjected to a transverse magnetic field. (auth)

26284 UNSTEADY FLOW IN THE SHOCK-TUBE MAGNETOHYDRODYNAMIC GENERATOR. Fishman, Frank J. (Avco Everett Research Lab., Everett, Mass.). Phys. Fluids, 11: 1012-19(May 1968).

In order to obtain some insight into unsteady magnetohydrodynamic channel flow, the flow in an idealized shock-tube generator is investigated theoretically. The treatment is limited to weak shocks, but is valid for arbitrary interaction parameters. The natural time scale of the flow is $\omega_0^{-1} = \rho_1/\sigma B^2(1 - \alpha)$, where ρ_1 is the density in front of the shock, σ the (constant, scalar) conductivity of the test gas, B the (constant) magnetic field, and α the (constant) load parameter. The shock decays in the time ω_0^{-1}, but the overall flow persists for times orders of magnitude longer. The electric power extracted initially rises linearly with the length of the test gas, but reaches a broad maximum after several characteristic times and delays only slowly thereafter. A detailed description of the flow is presented until it becomes a classical diffusion at values of $\omega_0 t$ greater than about 100. (auth)

26285 MAGNETOHYDRODYNAMIC EFFECTS IN A JOURNAL BEARING. Duszinsky, S. J. (Atomics International, Canoga Park, Calif.); Hughes, W. F.; Young, F. J. pp 163-97 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

An analytical and experimental investigation is made of the magnetohydrodynamic effects in a liquid-metal-lubricated partial journal bearing in which a dc magnetic field is applied tangentially to the bearing surfaces and transversely to the direction of motion of these surfaces, while an electric current is permitted to flow between the bearing surfaces which are the electrodes of an external circuit. The electrical terminal characteristics of this bearing are discussed, and it is shown theoretically that measurable changes in the performance characteristics can be affected by applying magnetic fields and external currents obtainable from conventional magnets and current sources. In particular, it is demonstrated that the journal friction is decreased and the load capacity is increased when current is forced to flow across the fluid film such that the resulting $\vec{J} \times \vec{B}$ force on the fluid is in the same direction as the rotation. The mathematical analysis reveals the existence of an optimum Hartmann number at which the load capacity peaks for a fixed applied current, this optimum value being about 5 for a dimensionless current I = −5 applied to a bearing with a width/diameter ratio of one and an eccentricity ratio of 0.6. The experimental model of the test bearing is described and the experimental and theoretical performances are compared graphically. When certain experimental difficulties are minimized, some degree of agreement is obtained between experiment and theory, and the experimental results show that the load capacity is in fact increased when an external current is injected in the proper direction. (auth)

26286 MOTION OF A PLASTIC-VISCOUS CONDUCTOR THROUGH A FLAT SLOT IN A TRANSVERSE MAGNETIC FIELD. Raichenko, A. I. (Inst. of Problems in Material Management, Kiev). Ukr. Fiz. Zh., 13: 427-32(Mar. 1968). (In Russian).

A velocity profile is obtained for one-dimensional motion of a plastic–viscous conducting medium in a transverse magnetic field as well as an expression for a component of the magnetic field in a motion direction. Inequalities are derived which are conditions of a plastic–viscous conductor extrusion through a flat slot by means of a travelling magnetic field. (auth)

26287 THEORETICAL STUDIES ON PERFORMANCE OF A MAGNETOFLUIDDYNAMIC (MFD) CONVERGING-DIVERGING NOZZLE. Bose, Tarit K. (Univ. of Minnesota, Minneapolis). J. Spacecraft Rockets, 5: 617-9(May 1968).

The application of magnetofluiddynamics to a converging–diverging nozzle to increase the acceleration (hence, specific impulse) of the already supersonic gas flow for the same back pressure and nozzle length is considered. The assumptions made are: (1) the flow is "one-dimensional"; (2) there are no viscous losses; (3) there is no axial heat conduction; (4) the gas through the nozzle is ideal and frozen; (5) the specific heat and electrical conductivity are constant; (6) there is a constant pressure gradient in the axial direction; (7) for the polytropic exponent, an average value can be taken; (8) the external magnetic field is constant; and (9) the external electric field is directly proportional to the fluid velocity. (M.H.R.)

26288 FREE SURFACE INSTABILITY IN ELECTROHYDRODYNAMICS. Michael, D. H. (University Coll., London). Proc. Cambridge Phil. Soc., 64: 527-34(Apr. 1968).

The theory of one of the simplest wave problems, namely plane free surface gravity waves, with a normal electrostatic field at the free surface is considered in detail. The inviscid problem previously studied by Taylor and McEwan is briefly recapitulated, and it is shown that the criterion for transition from stable to unstable waves is the same in both viscous and inviscid models. (auth) (UK)

26289 CONTRIBUTIONS TO A STUDY OF THE EFFECTS OF EXTREMETIES IN A GENERATOR WITH FINITE ELECTRODES. Dragos, Lazar (Univ., Bucharest). Proc. Cambridge Phil. Soc., 64: 535-48(Apr. 1968). (In French).

The motion of an electroconductive nonviscous incompressible fluid in a MHD generator of rectangular section having finite electrodes and the rest of its walls insulating is considered. It is assumed that in the electrode region a homogeneous magnetic field is applied, whose orientation is normal to the plane of the motion. If the induced magnetic field is neglected, the current function $\psi(x,y)$ and the electrical potential $\varphi(x,y)$ satisfy a system of equations with partial derivatives of the second order, with distributions. Since the system depends upon the parameter $\lambda = R_M R_H$ a method of successive approximations is developed, which permits obtaining the exact solution of the problem. The results are extended to the case of a generator with N pairs of symmetrical electrodes. (auth) (UK)

26290 INFLUENCE OF THE ELECTRICAL CONDUCTIVITY TENSOR ON FLUID MOTION IN A GENERATOR WITH FINITE ELECTRODES. Dragos, Lazar (Univ., Bucharest). Proc. Cambridge Phil. Soc., 64: 549- (Apr. 1968). (In French).

The influence of the electrical conductivity tensor upon the motion of a fluid in a MHD generator, under the conditions shown in the author's preceding work is considered. The problem is also formulated in terms of the theory of distributions, and the system of equations which determined the functions $\Psi = \psi + y$ and $\phi = \varphi + \varphi_0$ depends on two parameters λ and $\nu(=\omega\tau)$. Due to the Hall current the problem is no longer asymmetrical in the variable y, as in the first case; it therefore has to be separated into an asymmetric and a symmetric problem by developing a method of successive approximations as against two parameters it can be shown that the exact solution of the problem may be obtained. (auth) (UK)

26291 MASS TRANSFER IN ALIGNED-FIELD MAGNETOHYDRODYNAMIC FLOW PAST A FLAT PLATE. Tan, C. W. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.); Wang, Carl C. T. Int. J. Heat Mass Transfer, 11: 627-40(Apr. 1968).

Boundary-layer studies of the steady mass-transfer phenomena in an aligned-field magnetohydrodynamic flow past a semi-infinite flat plate are reported. The fluid is assumed to be viscous, electrically conducting, and incompressible. The plate is either porous, such that blowing or suction of a foreign diffusing fluid through the wall surface can be effected, or is made of a material which sublimes into the hot boundary-layer fluid, thus inducing a mass-transfer process. Other parameters being held constant, the skin friction, heat-transfer (except for negative Eckert numbers), and mass-transfer coefficients are decreased by a convective flow away from the wall surface (e.g. blowing or sublimation), and are increased by a convective flow toward the surface (e.g. suction or icing). The effects of the applied magnetic field are such that, for blowing and small suction rates, it decreases the skin friction, the induced magnetic field at the wall, the local heat-transfer coefficient, and the local mass-transfer coefficient; but at higher suction rates it increases all the above parameters, except for negative Eckert numbers. (auth) (UK)

26292 FINITE IONIZATION RATE EFFECTS OVER ELECTRODES IN MHD CHANNELS. Oliver, D. A. (Univ. of Santa Clara, Calif.); Mitchner, M. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 732-4(Apr. 1968).

In seeded noble gases at temperatures of ~2000°K flowing at velocities of hundreds of meters per second over electrode centimeters in length, the three-body recombination time is of the order of the plasma residence time over the electrodes. Such situations would be expected to give rise to electron number density distributions that have been driven out of Saha equilibrium by convection. Such finite rate effects were suggested by previous measurements of the spatial distribution of emitted radiation intensity in an MHD channel. Here, previous work is extended to include such finite ionization rate effects, and a qualitative explanation of the experimental measurements is given. (M.H.R.)

26293 EXPERIMENTAL STUDY OF NONEQUILIBRIUM IONIZATION IN A LINEAR MHD GENERATOR. Zauderer, Bert (General Electric Co., King of Prussia, Pa.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 701-7(Apr. 1968).

The primary purpose of this study was to obtain, through magnetically induced ionization, a plasma in which the electron temperature was significantly greater than the gas stagnation temperature. The magnetohydrodynamic (MHD) generator was mounted at the downstream end of a shock tube. Noble gases were shock-heated to static gas temperatures, corresponding to equilibrium electron densities n_e between 10^8 cm^{-3} and 10^{12} cm^{-3}. The major results were: 1) An initial n_e of the order of 10^{11} cm^{-3} was required at the generator entrance to obtain significant magnetically induced ionization; if n_e was produced by pre-ionization with an applied electric field, the pre-ionization power requirement was 10% of the maximum generator power output. 2) Electrode conduction losses controlled the minimum initial n_e requirement, the ionization growth rate in the generator, and the maximum generator power output. 3) The rate of ionization growth in the freestream of the generator was in agreement with the predictions of a one-dimensional theory in which electron collisional ionization and recombination dominated the rate equations. 4) The measured steady-state, electron densities in the generator were up to 1000 times greater than the corresponding values at the gas stagnation temperatures. The measurements were in general agreement with the theoretical predictions obtained from the electron energy equation and the Saha equation at the electron temperature. (auth)

26294 LAMINAR BOUNDARY LAYER OF A COMPRESSIBLE CONDUCTING GAS IN A TRANSVERSE MAGNETIC FIELD. Yuferev, V. S. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 6, 64-70(Nov.-Dec. 1967). (In Russian).

A parametric method which makes it possible to obtain a system of equations not dependent upon the nature of the flow in the outer stream is applied here to the calculation of the boundary layer of a compressible gas with temperature-dependent isotropic conductivity. It is assumed that the magnetic field is normal to the surface, the electric field is equal to zero, the gas is perfect, the magnetic Reynolds number is small, and the viscosity is a linear function of temperature. The method consists of substituting variables related to a longitudinal coordinate X for new variables (form parameters based on the boundary layer's characteristic thickness). A universal equation of a two-dimensional laminar boundary layer of conducting gas in a transverse magnetic field is derived and integrated by a 3M computer for cases where the electric conductivity inside the layer is smaller than on the boundary and the conductivity of the outer flow is equal to zero, respectively. The basic characteristics of the boundary-layer and velocity and temperature profiles are presented in graphs. They show that in the first case the gas is accelerated, velocity profiles become nonmonotonic, and the ratio between momentum and energy thicknesses decreases. In the second case, on the contrary, the gas is decelerated and the boundary layer thickness increases. It is stated in the conclusion that the rapid growth of the boundary layer which takes place when the conductivity of the outer flow is equal to zero shows the need to consider the main flow–boundary layer interaction. (ATD)

26295 CALCULATIONS OF A BOUNDARY LAYER AROUND A ROTATING DISK TAKING INTO ACCOUNT HALL EFFECT. Popel', A. S. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 6, 71-6(Nov.-Dec. 1967). (In Russian).

Stationary rotation of an infinite-radius disk in an anisotropic conducting incompressible fluid, in the presence of an axial magnetic field, produces around the disk a three-dimensional axially symmetric boundary layer, with all dimensions depending on only the two coordinates due to the symmetry factor. The problem reduces to one involving only ordinary differential equations. The numerical solution of the boundary layer on the disk is resolved, considering the Hall effect. (R.V.J.)

26296 SELF-SIMILAR AUTOMODEL SOLUTION FOR BOUNDARY LAYER OF NON-NEWTONIAN FLUID IN MAGNETOHYDRODYNAMICS. Sapunkov, Ya. G. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 6, 77-82(Nov.-Dec. 1967). (In Russian).

Solutions for the boundary layer of propagating pseudoplastic liquids were obtained, considering fluid interactions with an electromagnetic field in the case in which the electric conductivity is constant along the whole fluid flow in the magnetic field and the magnetic Reynold's number is small. The problem was set up for a non-Newtonian incompressible conducting flow in a plane boundary layer with the magnetic field intensity vector $\underline{H}$ perpendicular to the solid surface and the electric field intensity vector $\underline{E}$ perpendicular to $\underline{H}$ and the direction of gas flow along the solid surface. (R.V.J.)

Geophysics

Refer also to abstract 26158.

26297 (UCRL-18121) LOW-ENERGY ELECTROSTATIC INSTABILITIES IN THE MAGNETOSPHERE. Liu, Chuan Sheng (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 6, 1968. Contract W-7405-eng-48. 110p. Dep. CFSTI.

The stability of the Van Allen belt in the outer trapping zone ($2 < L < 8$) against electrostatic low-frequency perturbations is studied. Inside the plasmapause, the energetic belt ($E > 40$ keV) is found to be stable. Outside the plasmapause, the ring current belt is found to be unstable when the density gradient at the outer edge exceeds a certain critical value. A component of the electric field along the magnetic field line is associated with the instability. When the ring current belt is stable by itself, it supports a wave which can resonantly interact with the drift motion of the energetic particles. The condition for overstability is derived. The possible relevance of the instabilities to auroral phenomena is discussed. (auth)

26298 (MATT-Trans-56) PLASMA FLOW AROUND A TWO-DIMENSIONAL MAGNETIC DIPOLE. Managadze, G. G.; Podornyi, I. M.; Rusanov, V. D. Translation of a Russian report. 18p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The interaction of a supersonic plasma flow with the magnetic field of a dipole was investigated. Measurements were taken using a laser interferometer and magnetic probes. The results of the measurements are in agreement with the assumption of formation of a collisionless shock wave. (auth)

26299 ELECTRON PRODUCTION RATE IN IONOSPHERE OF POLAR CAP DUE TO SOLAR COSMIC RAYS. Velinov, P. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 1275-8(1967).

The rate of electron production in regions with increased ionization as a result of the interaction of soft solar particles (10 to 300 MeV) with the atmosphere is examined. (W.D.M.)

26300 COLLISION EFFECTS ON CHARGED PARTICLE DENSITIES IN THE TRAIL OF A SATELLITE. Albini, F. (General Research Corp., Santa Barbara, Calif.); Rand, S. Phys. Fluids, 11: 976-82(May 1968).

The effects of ion–electron collisions, on the structure of the satellite wake, have been studied. It is found that, in the daytime ionospheric F layer, due to these collisions the periodic variations in the ion and electron densities have largely disappeared at distances behind the vehicle greater than about 1 km. In other regions of the ionosphere, the distance required for the diffusing of the periodic structure scales with density as $n_0^{-\frac{1}{2}}$, where n_0 is the ambient electron density. It is suggested that, in their effects on the wake structure ion–electron collisions are generally more important than ion–ion collisions. (auth)

26301 COMPARISON OF IONOSPHERE DRIFT MEASUREMENTS IN THE LONG-WAVELENGTH RANGE AT TWO STATIONS AT A DISTANCE OF 300 KM FROM EACH OTHER. Sprenger, K. (Observatorium fuer Ionosphaerenforschung, Kuehlungsborn, Ger.); Schminder, R. Kleinheubach. Ber., 11: 79-87(1966). (In German).

Closely spaced receiver drift measurements in the lower ionosphere, using low-frequency radio transmitters at oblique incidence, were made nightly for several years at 2 stations in the German Democratic Republic, separated by a distance of about 300 km. After having successfully compared the mean drift results of these observations with the well-known radar meteor drift results of Jodrell Bank, a comparison was made between individual simultaneous drift measurements of the 2 stations in a synoptic way. It is shown that on 75% of the nights the results of the 2 stations were nearly identical, including synchronous rotations or sudden reversals of the observed drift vector. This was taken as confirmation of the significance of such observations. However, another 20% of the nights showed systematic rotations or reversals but with phase differences of several hours at the different observing sites. An explanation of these phenomena was based on an assumption of occasional strong vertical drift gradients in connection with slight variations of the reflection height. Seasonal anomalies of drift directions during spring and autumn, consisting of a temporary reversal of the prevailing drift westward and a simultaneous phase anomaly of the semi-diurnal component, were observed every year at nearly the same times at both stations. There was also another anomaly of drift direction in January, 1963, which possibly may be related to the strong stratospheric warming event of that winter. A slight sunspot cycle dependence of drift velocity and drift direction seemed to be discernible from the observations of one of the stations. (BBB)

26302 EFFECTS OF WINDS ON ACOUSTIC-GRAVITY WAVES ROM EXPLOSIONS IN THE ATMOSPHERE. MacKinnon, R. F. (Imperial Coll. of Science and Tech., London). Quart. J. Roy. Meteorol. Soc., 93: 436-54(Oct. 1967).

A study of seismic waves produced by nuclear explosions has yielded information concerning the structure of the Earth, and the same methods, mathematical and numerical, if applied to records of atmospheric waves from nuclear explosions, may yield information concerning the atmosphere. An attempt is made to show in what ways and to what extent ground pressure fluctuations are affected by wind, and to apply new knowledge derived from extensive computations relative to a particular model atmosphere to the interpretation of previously published microbarographic recordings. Some Japanese records of microbarographic data obtained during Russian nuclear tests and United States tests in the Marshall Islands are presented. It is shown that pressure fluctuations due to an explosive point source in an atmosphere containing steady winds may be described in terms of a fundamental mode of long period followed by modes of the acoustic and gravity type, with relative amplitudes, group speeds, and periods dependent upon winds. Far-field ground-pressure contributions of various modes are presented for a particular model atmosphere. Inverse dispersion and the Airy phase are found to be important features of the dispersion. A study was made of barograms in the light of new results obtained. Some previously unexplained features of barograms were shown to be attributable to winds. (BBB)

26303 INTERACTION OF THE MAGNETIZED SOLAR WIND WITH THE MOON. Whang, Y. C. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Fluids, 11: 969-75(May 1968).

The experimental results obtained from the Explorer 35 spacecraft indicate that a detached bow shock wave does not exist in the vicinity of the moon. Thus, the flow conditions near the moon do not resemble those near the magnetosphere of the earth. The solar-wind flow around the moon is treated theoretically as a free-molecule flow of guiding-center plasma. Analytical results are obtained to describe the ion flow in the vicinity of the moon. The disturbed region forms a long wake in the downstream of the moon. The thickness of the wake, measured perpendicular to the plane of the solar-wind velocity and the interplanetary magnetic field, is constant at one lunar diameter. On the other hand, the width of the wake, measured parallel to that plane, increases with distance from the moon. (auth)

26304 TERMINATION OF MAGNETIC CONJUGACY AT HIGH LATITUDES. Dessler, A. J. (Rice Univ., Houston, Tex.). pp 105-17 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

The effect of a long geomagnetic tail on magnetic conjugacy is discussed. It is concluded that conjugate phenomena (e.g., the travel of electromagnetic wave packets or charged particles from a point on one hemisphere of the earth directly along a magnetic line of force to the conjugate point on the opposite hemisphere) should cease abruptly at latitudes poleward of the local auroral zone. An attempt is made to describe quantitatively diurnal and seasonal changes in the latitude at which magnetic conjugacy vanishes. (auth)

26305 SOLAR-FLARE X-RAY EMISSION PRODUCING GEOMAGNETIC PULSATIONS. Pinter, S. (Geophysical Inst., Hurbanovo, Czech.). Bull. Astron. Inst. Czech., 19: 97-9(1968).

During the IGY, using very sensitive rapid-run induction magnetometers at the Japanese observatory at Onagawa, it was found that intense solar flares are accompanied by geomagnetic pulsations, lasting several minutes and having a period of 70 to 80 sec. An investigation of geomagnetic pulsations, recorded during the period 1958–66, which occur at the time of solar flares, is presented here. (W.D.M.)

26306 SECULAR CHANGES IN THE EARTH'S MAGNETIC FIELD IN BULGARIA DURING THE PERIOD 1955 TO 1964. Zidarov, Dimitar; Kostov, Kosta. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 10: 107-22(1967).

The points of the secular network in Bulgaria in which absolute measurements of the magnetic elements H, Z, and D are taken every year are described. The coordinates of the points and the mean annual values of these elements for the period 1955–1964 are given. The method of work and the equipment used are described. The errors in the absolute observations and the values of the mean annual variations of H, Z, and D are estimated. (Abstr. Bulg. Sci. Lit.)

26307 THE WINTER ANOMALY AND THE IONOSPHERIC E LAYER. Serafimov, Kiril; Samardziev, Dimitar. Izv. Geofiz. Inst., Bulg. Akad. Nauk, 10: 43-58(1967).

On the basis of the equation for continuity (the equation for the ionization and neutralization balance) a criterion is elaborated

about the existence of an anomalous state in the ionization state of the E layer. For this purpose use is made of the seasonal changes and of the changes due to the solar activity of the critical frequencies f_0E, as well as of the aeronomic parameters σ, H, and α. It is clear from the application of the theoretical results to the data from the observations at 46 ionospheric stations, that the fundamental causes of the "winter anomaly" are a result of not taking into account the seasonal changes in the height of maximal electronic concentration, the changes in solar activity, and in the symmetry of the daily variation of the critical frequencies. It is also established that for a constant zenith angle of the Sun, f_0E correlates very well with the relative number of sunspots. The conclusion is drawn that no winter anomaly exists in the ionization state of the E layer. (Abstr. Bulg. Sci. Lit.)

26308 HYDROMAGNETIC WAVE INSTABILITIES IN A NON-NEUTRAL PLASMA–BEAM SYSTEM. Kimura, I.; Matsumoto, H. (Kyoto Univ.). Radio Sci., 3: 333–43(Apr. 1968).

Hydromagnetic wave instabilities excited by an electron or ion beam passing through the magnetospheric plasma are investigated especially for the case when the wave frequency ω and wave number k are small and an excess charge remains in the medium. It is found that the electron excess beam causes instability in the Alfvén mode wave and the positive excess charge beam does so in the modified Alfvén mode wave. The frequency of the instabilities is roughly proportional to the excess charge density and to the ion gyrofrequency. The physical picture of this instability is given in terms of wave–wave interaction. The major morphological features of the pc-5 micropulsation can be interpreted by this instability, if there exists an excess charge beam of electrons or ions in the magnetosphere. (auth)

26309 S_q AND THE ELECTROMAGNETIC ACTIVITY OF THE EARTH. PART I. Adam, A. (Hungarian Academy of Sciences, Sopron). Acta Geod. Geophys. Montanistica, 2: 103–20(June 15, 1967). (In Russian).

In a paper presented at the VIIth Conference on the Geophysics of the European–Asian Region, held in Moscow, 1964, the author discusses the "quiet days" free from corpuscular disturbances for the study of the terrestrial electromagnetic field. He analyzes the average rate of quiet days from the maximum in 1957-58 until 1963 of the small sunspot number with the aid of the various parameters. The data were based on observations at Nagycenk Observatory. Certain trends were observed. (JPRS)

26310 AN ELECTROSTATIC PROBE FOR IONOSPHERIC MEASUREMENTS OF ELECTRON DENSITY AND TEMPERATURE. PART II. REALIZATION OF THE PROTOTYPE AND LABORATORY TESTS. Bruscaglioni, P.; Cappellini, V.; Pellegrini, P. F. (Univ., Florence). Alta Freq., 36: 664–71(1967). (In Italian).

A probe for measurements of electron density and temperature in the atmosphere is described. Elements of the apparatus are described in detail, particularly the polarization circuits and the electrometer: block diagrams, circuits, and photographs of the actual apparatus illustrate the probe. The electron temperatures measured in the laboratory tests ranged to 20,000°K, far in excess of the temperatures to be found in the region for which the instrument is designed. Appropriate grid and collector voltages for maximum efficiency are determined, and examples of the electron current monitored under laboratory conditions are illustrated by oscillograph traces. The suggestion that the instrument can be used for E and F regions of the ionosphere, and for satellite explorations of the ionosphere with nonessential modifications, is made. (BBB)

26311 EXPLORATION OF THE D REGION OF THE IONOSPHERE BY ROCKET ASCENT. Faust, Heinrich. Naturwiss. Rundsch., 20: 394(Sept. 1967). (In German).

The D region of the ionosphere, between 60 and 90 Km, corresponds approximately to the region where NO is ionized by the Lyman α radiation of the sun. A hard x-ray source is apparently the source of greatly increased electron concentration. Because the mesosphere (50 to 80 Km) is of great interest to meteorologists, collaboration between meteorologists and ionosphere researchers is encouraged. The European Space Research Organization predicts that in the next few years perhaps 20 rockets per year will be used for a variety of purposes; geographical bases for these tests will include Kiruna (Sweden) and Sardinia, and conceivably the French Sahara and the Hebrides. Many single measurements should be made by a single rocket, and apparatus for this sort of study must first be developed. Origins of the D region are suggested. (BBB)

26312 GEOMAGNETIC SOLAR QUIET DAY VARIATION S_q ACCORDING TO LT FROM THE NIGHT TIME DATUM AT INDIAN STATIONS DURING 1958. Gupta, B. R. D. (Colaba Observatory, Bombay). Indian J. Meteorol. Geophys., 17: 643–8 (Oct. 1966).

The so-called solar quiet-day variations S_q can, in general, be derived from the 5 most quiet days of the month. The monthly means of hourly values for the 5 international quiet days of the month are then corrected for the noncyclic change to obtain the hourly departures of these corrected values from a fixed datum. The S_q variation was derived for Alibag, Annamalainager, and Trivandrum for 1958 from retabulated hourly values of H field according to LT (local time, IST) for the 5 international quiet dates nearest to the local days, from the daily mean as well as from the night time level. Noncyclic change was calculated according to LT. A Fourier analysis of the S_q derived in the above manner was performed and the results with the data published in the Bombay Volumes where S_q and noncyclic change are derived according to GMT (Greenwich mean time). It was observed that there is considerable difference (of the order of 0 to 10 γ) in the 2 estimates of the noncyclic change, but a small difference (of the order of 0 to 2γ) in the amplitudes of the harmonic coefficients of the S_q derived in the 2 ways. It was concluded that S_q should preferably be derived from the local time and night time datum. (BBB)

26313 IONOSPHERIC DIFFUSION PROBE SYSTEM. du Castel, F.; Carru, H.; Petit, M.; Waldteufel, P. Flugwelt, 19: 242–3(Apr. 1967). (In German).

The CNET has developed a new type of research instrument for the study of the upper atmosphere by using incoherent diffusion through the ionospheric plasma. The instrument permits continuous measurement of ionospheric parameters, a technique which surpasses all other experimental techniques employed until now. Two different antennas are used for sending and receiving signals instead of one, and volumes are determined by the geometries of both antennas. Good spectral analysis of the diffused signal is possible because of the continuous mode of operation. Determination of ionization profile requires more time than the impulse technique. The apparatus is located at St. Santin de Maurs in the Massif Central for reception; the transmitter is at Nancay, 300 Km north, and uses 935 MHz. Helium was shown to be present between the low region where O_2 predominates and the higher regions where H_2 predominates. The thermodynamic inequality in the upper atmosphere between ions and electrons is also being studied. (BBB)

26314 ON THE ELECTRIC DRIFT ORIGINATING IN THE IONOSPHERE DURING MAGNETIC STORMS. Chiet, Le Minh (Eotvos Lorand Scientific Inst. for Geophysics, Budapest). Acta Geod., Geophys. Montanistica, 2: 145–51(June 15, 1967). (In Russian).

Movements taking place in the magnetosphere and in the lower parts of the ionosphere produce an electric field. In magnetic storms, the movement of the magnetosphere, caused by the compression effect of the solar wind, plays an important role in the creation of an ionospheric disturbance arising in the F2 layer. Induction and polarization generally contribute to the generation of the electric field. As a consequence of this field, the ionospheric plasma moves: the decreasing and increasing ionization in the starting phase of the magnetic storm can be interpreted in terms of these findings. An explanation is presented for the main phase of the ionospheric storm. (JPRS)

26315 THE SEASONAL AND SECULAR CHARACTERISTICS OF THE AVERAGED DIURNAL VALUE OF THE F2-LAYER CRITICAL FREQUENCY (ΣfoF2) AT CONJUGATE MAGNETIC LATITUDES. Lal, Chaman (Dept. of Communications New Delhi). Telecommun. J., 34: 389–93(Oct. 1967).

It is shown that the monthly mean of the average diurnal value of the critical frequency ($\Sigma\overline{foF2}$), averaged over any pair of conjugate magnetic (dip) latitudes, shows seasonal and secular characteristics similar to those shown by the planetary F2-layer ionization ($\Sigma\overline{foF2}$) . The combined average ionization along any pair of conjugate dip latitudes shows a marked biannual periodicity, with maxima appearing regularly in April and October of each year. This averaged trend may be represented by the simple relations: $(\Sigma\overline{foF2})^2 \pm Z^0 \text{ dip} = K' \times F_{10} \times SEF$, where K' is a constant of proportionality; F_{10} is the solar flux at 2800 Mcps expressed in W/m^2 cps $\times 10^{-22}$, as reported by Covington; and SEF is the seasonal enhancement factor, as explained by the author previously. The SEF monthly values, averaged over the period 1953–1961, are tabulated. The value of K' for the period of analysis 1953–1961 was found to be 0.32. Analysis indicated that the equinoctial enhancement of planetary F2-layer ionization cannot be explained on the basis of transport of ionization from one latitude to another, or alternatively, on the basis of any of the current theories, which involve solar uv radiations only. Such a feature calls for an additional source of F2-layer ionization which could be corpuscular radiation of solar origin. (BBB)

26316 ALBEDO NEUTRON SOURCE FOR HIGH-ENERGY PROTONS TRAPPED IN THE GEOMAGNETIC FIELD. Intriligator, Devrie S. (Univ. of California, Los Angeles). Phys. Rev. Lett., 20: 1048-9(May 6, 1968).

An absolute intensity measurement of cosmic-ray neutrons in the atmosphere, in the energy range from thermal to 20 MeV, leads to a value of 0.36 ± 0.06 neutron cm^{-2} sec^{-1} for the albedo neutron leakage flux at 42° geomagnetic latitude near solar minimum. The significance of this value for evaluating the contribution of the cosmic-ray albedo-neutron-decay source for the high-energy protons in the inner radiation belt is discussed. (auth)

26317 RADIO-FREQUENCY SYNCHROTRON RADIATION FROM ELECTRONS TRAPPED IN THE EARTH'S MAGNETIC FIELD. Vesecky, John Fenwick. Stanford, Calif., Stanford Univ., 1967. 169p.

Thesis.

The basic problem analyzed is the nature of the radiofrequency synchrotron noise, due to electrons in the natural Van Allen belts, that could be observed by a high-altitude satellite. This problem is considered in terms of radiative transfer, i.e., the transfer of electromagnetic energy from the radiating electrons along a ray path that terminates at the satellite receiver. Estimates of satellite-observed synchrotron emission are made by applying the appropriate solution of the radiative transfer equation to a magnetospheric plasma model based on satellite- and ground-based measurements. (TSS) (Disser. Abstr.)

26318 KHIMIYA IONOSFERY. (Chemistry of the Ionosphere). Danilov, A. D. Leningard, Gidrometeorologicheskoe Izdatel'stvo, 1967. 295p.

Basic chemical and photochemical processes occurring in the earth's ionosphere at altitudes of some 60 km and more are considered. A chart of ionization and recombination cycles is presented. A description is given of ion and molecule reactions and of dissociative recombination. Chemical kinetics of the lower ionosphere and reactions with negative ions taking part are also discussed. An analysis is given of nitrogen and oxygen dissociation, the chemistry of nitrogen oxides, and hydrogen combinations in the upper atmosphere. (555 references) (auth)

26319 RADIATION BELT AND MAGNETOSPHERE. Hess, Wilmot N. A Blaisdell Book in the Pure and Applied Sciences. Waltham, Mass., Blaisdell Publishing Company, 1968. 548p.

Major topics examined include the nature of particles trapped within the radiation belt and their energy distribution, their source, and the cause of their loss from the belt. The questions of particle motion within the belt, the relationship of its inner and outer zones and the aurora, and the nature of the outer edge (magnetopause, tail, and bow shock) are considered. (W.D.M.)

26320 ATMOSPHERIC MOTIONS DEDUCED FROM GEOMAGNETIC VARIATIONS ASSOCIATED WITH SOLAR FLARES. Greenfield, Stanley Marshall. Los Angeles, Univ. of California, 1967. 114p.

Thesis.

Certain short-lived variations of the geomagnetic elements which occur simultaneously with intense solar flares and are confined mainly to the sunlit side of the Earth are known as SFEs (Solar Flare Effects). The SFEs are produced by currents due to enhanced ionization of the E and D regions of the ionosphere by x rays (<200 Å) originating from the flare. The SFE currents arise in the same manner as S_q currents responsible for the quiet-day variation of the magnetic elements; i.e., they are generated by the dynamo action of winds blowing charged particles across the Earth's permanent magnetic field. It is the objective of the present investigation to explore to what extent the detailed time history of SFE current systems can provide information regarding ionospheric winds. The magnetic variations produced by the solar flare (importance 3B) of August 28, 1966 (1522UT), and recorded at 36 magnetic observatories are analyzed in detail. The associated height integrated SFE current systems are portrayed at intervals of 2.5 minutes during a 40 minute period following flare commencement. It is noticed that initially the SFE current system has a direction of flow which is the reverse of the quiet-day (S_q) current system. As the flare intensifies, however, the reversed system is replaced at middle latitudes by a current system that is an augmentation of S_q. The reversed system persists, at high latitudes even at the time of maximum flare, and tends to extend into the lower latitudes as the flare decays. The observed sequence of the SFE current systems for this flare event is interpreted in terms of a time-dependent spectral output from the Sun and altitude-dependent wind (and conductivities) in the current-carrying layers of the ionosphere. In order to give quantitative basis to this interpretation, a program is developed for solving numerically the dynamo equation generalized to the case where the ionospheric wind and conductivities are functions of altitude, and geographic latitude and longitude. Typical current systems produced by a simplified solar flare model and various hypothetical combinations of periodic and nonperiodic winds in the ionosphere are illustrated. It is concluded that SFE current systems deduced for the flare imply a global wind pattern that varies appreciably with altitude, in the D and E regions of the ionosphere. (Disser. Abstr.)

Low-Temperature Physics

Refer also to abstract 26516.

26321 (ANL-Trans-598) INVESTIGATION OF SUPERCONDUCTING CHARACTERISTICS OF Nb-Ti-ALLOYS. Baranov, I. A.; Boikova, K. I.; Guts, Z. A.; Kurakina, L. A.; Kogan, A. V.; Fogel, A. A.; Tsypkin, S. I.; Shmuelvich, R. S. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Fizika Tverd. Tela, 10: 404-10(1968). 14p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The critical temperatures and current densities have been measured for superconducting Nb–Ti alloys prepared by melting in an electromagnetic crucible. The effect of microinhomogeneities upon the critical current density has been studied. It is shown that large inhomogeneities correspond to higher critical current densities. (auth)

26322 BILINEAR ELECTRODYNAMICS OF A SUPERCONDUCTOR. Jha, Sudhanshu S. (Tata Inst. of Fundamental Research, Bombay). pp 31-43 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.1).

The nature of the linear electromagnetic response of a metal in both normal and superconducting states is reviewed. Within the framework of the BCS theory of superconductivity, the bilinear response of a superconductor to a double-frequency laser beam is discussed. It is shown that it is possible to demodulate a microwave frequency $2\epsilon/h$, where 2ϵ is the energy gap of the metal in the superconducting state, by using a superconducting metal as bilinear reflector. (auth)

26323 CRITICAL FIELDS H_{c2} AND H_{c3} OF THIN FILM TYPE-II SUPERCONDUCTORS. Rajput, J. S.; Gupta, A. K. (Univ. of Allahabad, India). pp 44-7 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.1).

Ginsburg–Landau (GL) equations are solved for thin type-II film superconductors placed in parallel magnetic field. One-dimensional GL equations in reduced variables are first converted to a set of coupled integral equations by using a Laplace-transform method. The resultant integral equations are iterated to give approximate analytic solutions. The critical fields H_{c2}, for vanishing of volume superconductivity, and H_{c3}, for vanishing of surface superconductivity, are calculated for such films. (auth)

26324 ORBITAL PARAMAGNETISM IN SUPERCONDUCTORS. Vijayaraghavan, R. (Tata Inst. of Fundamental Research, Bombay). pp 144-51 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.1).

One of the consequences of the BCS microscopic theory of superconductivity is that the spin susceptibility of the conduction electrons will vanish exponentially as the reduced temperature T/T_c approaches Zero. This follows from the fact that all states are chosen to be eigenstates of the total spin and the ground state of the superconductor is one for which the expectation value of the spin is zero. It is therefore of some interest to measure the temperature dependence of the spin paramagnetism and the Knight shifts, which result from Pauli paramagnetism (below T_c). The relevant data on superconductors are discussed and the importance of orbital paramagnetism in metals is stressed. (auth)

26325 TRANSITION TEMPERATURE AND TEMPERATURE DEPENDENCE OF ENERGY GAP IN THIN-FILM SUPERCONDUCTORS. Rajput, J. S.; Gupta, Ashok Kumar (Univ. of Allahabad, India). pp 48-51 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.

See CONF-670220-(Vol.1).

The Gorkov equations are solved for a superconducting film. The important role of the energy level quantization of single-

particle states in thin films is explicitly taken into account from the beginning. The single-particle Green function is expanded in terms of the complete set of orthonormal eigenfunctions. Gorkov equations are then iterated to an arbitrary order and the energy gap in the quasi-particle spectrum is determined. The transition temperature for thin films is determined from the iteration to the lowest order, while the temperature dependence of the energy gap near the transition temperature has been determined from iteration up to the third order. The temperature dependence of energy gap can be determined up to lowest temperatures, and thanks to the orthonormality of eigenfunctions, it is possible to write down all the terms of the series in quite simple form. Numerical results are presented for thin films by taking the iterated solution up to the third order only. (auth)

26326 PROXIMITY EFFECT: NUMERICAL EVALUATION OF THE SUPERCONDUCTING TRANSITION TEMPERATURE. Yeh, Robert H. T. (Univ. of Illinois, Urbana). Ann. Phys. (N. Y.), 46: 546-58(Feb. 1968).

De Gennes' equation for the gap parameter in superposed films of normal and superconducting materials have been solved via a numerical technique. This is based upon a variation approach used by Silvert and Cooper. The solution indicates that the approximate analytical procedure used by Werthamer is accurate for thick dirty films. However, for thinner cleaner films, the solutions lead to improvements as big as 25% over Werthamer's method. This improvement is mainly a result of better treatment of the behavior of the gap parameter near the interface. (auth)

26327 INFLUENCE OF EXTENDED DEFECTS ON SUPERCONDUCTING PROPERTIES OF NIOBIUM. Goodman, B. B.; Kuhn, G. (Centre de Recherches sur les Tres Basses Temperatures, Grenoble, France). J. Phys. (Paris), 29: 240-52 (Feb.-Mar. 1968). (In French).

Superconducting magnetic properties, normal and superconducting thermal conductivity (K_n and K_s respectively), and residual resistivity measurements, and electron microscope observations were performed with several niobium single crystals. Comparison of the magnetization measurements with the theoretical predictions for type-II superconductors shows, in particular, how the temperature variation law of the Ginzburg–Landau–Maki parameter, κ_2, evolves with the electron mean free path. Furthermore, the surface effects were characterized in a very sensitive manner by the first penetration field. The use of a simple model allows a value of the critical current to be calculated from a magnetization curve. This value is compared with the extended lattice defects density, deduced from K_s, and with their nature, observed with the electron microscope. (auth)

26328 PROPERTIES OF ^{3}He AND ITS SOLUTIONS IN ^{4}He. Peshkov, V. P. Usp. Fiz. Nauk, 94: 607-40(Apr. 1968). (In Russian).

A brief review is given on the available data on the principal properties of ^{3}He and its solutions in ^{4}He. The new entropy diagram for ^{4}He is analyzed, and its transition into the superfluid state is discussed. Experimental data on ^{3}He and its solutions are compared with theoretical results based on Fermi-gas and Fermi-liquid theories. 147 references. (R.V.J.)

26329 LATTICE EXPANSION AND SUPERCONDUCTIVITY OF Nb_3Sn AS A FUNCTION OF HYDROGEN CONTENT. Sahm, P. R. (RCA Labs., Princeton, N. J.). Phys. Lett., 26A: 459-60(Apr. 8, 1968).

Hydrogen was dissolved in Nb_3Sn by treating powders with boiling HCl, by electrolysis, and by annealing of powders in an H_2 atmosphere. Remarkable lattice expansions were observed. After an initial rise in the transition temperature, superconductivity disappeared completely at higher H concentrations. (auth)

26330 HIGH-FIELD SUPERCONDUCTOR TECHNOLOGY. Laverick, Charles (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Spectrum, 5: No. 4, 63-74(Apr. 1968).

The types, materials, and performance of supermagnets are reviewed. The present magnets are discussed. Cryogenic requirements and supermagnet applications are covered. (M.H.R.)

26331 DETERMINATION OF THE VELOCITY OF HIGH-FREQUENCY SOUND IN LIQUID ^{3}He BY X-RAY SCATTERING. Shah, Nareshchandra P. (Stanford Univ., Calif.). Phys. Rev. Lett., 20: 1026-9(May 6, 1968).

The velocity of high-frequency sound in liquid ^{3}He was studied by scattering x rays from the liquid and observing the temperature dependence of the scattering cross section at small angles. At temperatures above 0.8°K good agreement with previous ultrasonic measurements was found. At temperatures below 0.8°K the velocity of sound rose above those values obtained from ultrasonic measurements. Zero-point scattering was also observed at low temperatures. (A.G.W.)

26332 ANISOTROPIC ENERGY-GAP MEASUREMENTS ON SUPERCONDUCTING NIOBIUM SINGLE CRYSTALS BY TUNNELING. MacVicar, M. L. A.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 39: 1721-7(Feb. 15, 1968).

Nb/oxide/In tunneling junctions were constructed on the as-grown surfaces of Nb single crystals at controlled orientations. The energy gap was observed to be anisotropic for crystals with resistivity ratios of 178 or greater. The lowest gap, 2.84 mV, was observed for the ⟨100⟩ direction. Local gap maxima were observed at the ⟨311⟩ and ⟨111⟩ directions, where the gap was about 3.19 mV. No anisotropy was observed in crystals having resistivity ratios of 65, presumably due to impurity scattering. Some coincidence of the energy gap anisotropy with main features of the proposed group V transition metal Fermi surface is noted. (auth)

26333 CALCULATION OF THE COMPLEX ELECTRICAL CONDUCTIVITY OF SUPERCONDUCTING LEAD AND TIN. Shaw, William; Swihart, James C. (Indiana Univ., Bloomington). Phys. Rev. Lett., 20: 1000-3(Apr. 29, 1968).

The complex electrical conductivity is calculated by the strong-coupling theory for superconducting lead and tin. The theory is shown to be internally consistent and in agreement with Palmer and Tinkham's experiments. It is demonstrated that the real part is simply related to the real part of the gap function for large frequencies. (auth)

26334 DETAIL IN THE TUNNELING CHARACTERISTICS OF SUPERCONDUCTING NIOBIUM SINGLE CRYSTALS. MacVicar, M. L. A.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 26A: 510-11(Apr. 8, 1968).

Structure has been detected in tunneling data for high-purity single-crystal Nb which suggests a complicated excitation spectrum. (auth)

26335 LONGITUDINAL TEMPERATURE DISTRIBUTION IN LOW-TEMPERATURE CABLES WITH COUNTERFLOW COOLING. Edney, K.; Fox, M.; Gilbert, G. (British Insulated Callender's Cables Ltd., London). Cryogenics, 7: 355-8(Dec. 1967).

The tendency for a thermal short-circuit to develop in a cable cooled by streams of fluid flowing in opposite directions, due to the finite thermal conductance between the streams, is considered. A criterion is derived for the maximum value of this conductance which is acceptable in the design of cables. Examples of the application of this criterion are given. (auth)

26336 NEW FORM FOR THE THERMODYNAMIC POTENTIAL OF He II NEAR T_λ. Amit, D. J. (Hebrew Univ., Jerusalem). Phys. Lett., 26A: 466-7(Apr. 8, 1968).

A new thermodynamic potential function is presented for temperatures just below T_λ which reproduces the $(T_\lambda - T)^{\frac{1}{2}}$ behavior of ρ_s and the critical velocity v_c. (auth)

26337 NOTE ON THE VORTEX DENSITY IN ROTATING HELIUM II. Stauffer, D. (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Pobell, F.; Schoepe, W. Phys. Lett., 26A: 465-6(Apr. 8, 1968).

Computer calculations show that there exist no large stable deviations from the homogeneous vortex density in an annulus or cylinder; the solutions of Masson and Tien are unstable. (auth)

26338 PASSAGE OF POLARIZED NEUTRONS THROUGH TYPE II SUPERCONDUCTORS. Rauch, H.; Weber, H. W. (Oesterreichische Hochschule, Vienna). Phys. Lett., 26A: 460-1(Apr. 8, 1968).

The interaction of polarized neutrons with superconductors in the Meissner, intermediate, and mixed state is described. In increasing fields, only hysteretic type-II superconductors show a distinct neutron depolarization. The almost ideal type-II superconductors do not affect the polarization. (auth)

26339 RECOMBINATION TIME OF QUASIPARTICLES IN SUPERCONDUCTING ALUMINUM. Levine, James L.; Hsieh, S. Y. (Columbia Univ., New York). Phys. Rev. Lett., 20: 994-7(Apr. 29, 1968).

The quasiparticle recombination time τ_r, was measured in superconducting aluminum films. The temperature dependence of τ_r at low temperatures was found to be in good agreement with theoretical expectations. (auth)

26340 SUPERCONDUCTIVITY AND THE LATTICE INSTABILITY IN V_3Si. Finlayson, T. R.; Vance, E. R.; Rachinger, W. A. (Monash Univ., Clayton, Victoria). Phys. Lett., 26A: 474-5(Apr. 8, 1968).

A correlation is reported between T_{min} (the temperature at which the lattice instability in some V_3Si samples is arrested) and T_c (the superconducting transition temperature). A depression of T_{min} with magnetic field is also reported. (auth)

26341 SUPERCONDUCTING MAGNETS. Kremlev, M. G. Usp. Fiz. Nauk, 93: 675-701(Dec. 1967). (In Russian).

A brief review is given on the history of superconducting magnets. Chapters are devoted to normal state and superconducting transitions, the discontinuity and degradation of the flux, thermal stability of superconducting coil windings, and the properties of the universally used superconducting materials. 87 references. (R.V.J.)

26342 THE SUPERCONDUCTING TRANSITION TEMPERATURE OF $La_{1-x}Gd_xAl_2$. Maple, M. B. (Univ. of California, San Diego, La Jolla). Phys. Lett., 26A: 513-14(Apr. 8, 1968).

The dependence of the superconducting transition temperature on the concentration of Gd spins is reported for $La_{1-x}Gd_xAl_2$. The results are in good agreement with the theory of Abrikosov and Gor'kov to concentrations very near the critical concentration. (auth)

26343 TUNNELING OF SUPERCURRENT THROUGH BARRIERS CONNECTED IN SERIES. Kao, Yi-han (State Univ. of New York, Stony Brook). Phys. Lett., 26A: 471-2(Apr. 8, 1968).

Experimental studies of Josephson junctions connected in series were made and I–V characteristics for the series circuit were compared with those for the individual junctions. (auth)

26344 WAVE MODES IN LIQUID HELIUM CAPILLARIES. Meinhold-Heerlein, L. (Johannes Gutenberg-Univ., Mainz). Phys. Lett., 26A: 495-6(Apr. 8, 1968).

In liquid helium two wave modes are possible. Their properties are calculated for a plane-parallel capillary. (auth)

26345 PARTICLE MOTION AND HEAT-EXCHANGE VISCOSITY IN SUPERFLUID HELIUM. Penney, R.; Hunt, T. K. (Ford Motor Co., Dearborn, Mich.). Phys. Rev., 169: 228 (May 5, 1968).

It is pointed out that a uniformly heated sphere experiences a nonzero drag force due to purely potential flow of superfluid. For small velocities, the resulting motion of heated trace particles in helium will arise from a competing drag due to normal and superfluid components. The motion of such particles will be strongly dependent upon experimental conditions, such as temperature, particle size, and lighting. (auth)

26346 SUPERCONDUCTIVE PROPERTIES. Roberts, B. W. (General Electric Co., Schenectady, N. Y.). pp 581-613 of Intermetallic Compounds. Westbrook, J. H. (ed.). New York, John Wiley and Sons, Inc., 1967.

The theory relating to superconductive compound formation is reviewed. Superconductive properties of specific structure types are tabulated, including $Cr_3O(\beta-W)$-type phases, the sigma-phase and related structure types, the Laves phases, and other compounds. The high-field magnetic properties are discussed. 157 references (M.H.R.)

26347 INVESTIGATION OF HIGH-FIELD SUPERCONDUCTING COMPOUNDS. Olson, Zelma Johnston. Berkeley, Calif., Univ. of California, 1967. 46p.

Thesis.

Only three β-Mn structures (interstitial compounds) are known to be superconductors, two of which were discovered at Berkeley. Compounds of this type appear to have excellent potentials as high-field materials, when judged by a comparison of upper critical field to transition temperature. A review of the crystal structure and superconductivity of β-Mn structure compounds is presented here along with a report of the discovery of a new superconductor in this structure (the third of the group mentioned above). The new compound is W_3Re_2C, which has a T_c of 7.4°K. A discussion of the electron-to-atom ratio as applied to these filled interstitial alloys is also included. The behavior of commercial hard superconductors is extremely sensitive to microstructure and the improvement of superconducting properties of transition metal alloys by controlled microstructure has recently become very important. A study of the effect of microstructure in two phase compounds and alloys of transition metals is presented. One result has been the synthesis of a two phase high-field superconductor with filamentary microstructure (Nb_3Sn in a NbC matrix, critical field higher than 200 kG at low current densities). A second significant accomplishment was the increase of the superconducting transition temperature of Ta–50% Zr alloys by controlling the formation of the precipitate within the miscibility gap composition range of the Ta–Zr system. (Disser. Abstr.)

Plasma and Thermonuclear Physics

Refer also to abstract 27455.

26348 (AED-C-03-17) PLASMA PHYSICS INDEX. EXPERIMENTAL AND THEORETICAL PLASMA PHYSICS. Bibliography; Author Index; Subject Index. Volume 3, No. 2. Hilsenbeck, D. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 237p. Dep.

A listing of 437 articles is presented. Complete author and subject indexes are included. (M.O.W.)

26349 (IPPCZ-72) ANNUAL PROGRESS REPORT [ON PLASMA PHYSICS], 1966. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jan. 1967. 81p. Dep.

Research is described on various aspects of beam–plasma interactions, hf field–plasma interactions, low-pressure discharge plasma, and vacuum technology. (M.O.W.)

Confinement and Heating of Plasma

26350 (IPPCZ-77) TO THE THEORY OF THE STOCHASTIC HEATING OF PARTICLES. Krlin, L. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jan. 1967. 28p. Dep.

The form of the distribution function $f(P_i,Q_i,t)$ is determined in terms of the integral W of the diffusion equation and of the initial distribution function $f_0(P_i,Q_i,t_0)$. W gives the probability of the occurrence of a particle in the phase space P_i,Q_k; the function can readily be found in case the magnetostatic field is homogeneous and it is possible to assume that either $D_i = 0$ (this corresponds to the feasibility of linearizing the equations of motion) or $D_i \neq 0$, $D_{ik} \neq 0$, at which both kinds of the components of the diffusion tensor are constant. Particularly simple analytical expressions can be obtained whenever the initial distribution function is a δ function or a function of the Maxwellian type. The effects of nonlinearities (i.e. the effect of $D_i \neq 0$) are discussed; as the analysis indicates, $D_i \neq 0$ causes the asymmetry of the diffusion: the diffusion process is slowed down or accelerated, depending on the value of D_i. The Hamiltonian function of the particle and the distribution function f obtained in the above way are used for establishing the value of the absorbed energy and the rate of absorption. The conservative rf field–particle system is discussed, and a set of equations describing the change of the distribution function and of the spectrum energy is deduced for the case when the rf field is specified by the scalar potential. (auth)

26351 (MATT-477) 100-kV IGNITRON SWITCH. Murray, John G. (Princeton Univ., N. J. Plasma Physics Lab.). Dec. 1966. Contract AT(30-1)-1238. 18p. Dep. CFSTI.

A group of 5 standard ignitrons, generally used in 600-volt welding circuits, were successfully operated in series to provide a reliable 100-kV switch which turns on in microseconds. The uses and characteristics of the switch are briefly described. (M.O.W.)

26352 (NYO-2813-39) DIFFUSION MEASUREMENTS IN POTASSIUM MAGNETO-PLASMAS. Rogers, K. C.; Courville, G. E.; Wolf, N. S. (Stevens Inst. of Tech., Hoboken, N. J.). [1966]. Contract AT(30-1)-2813. 11p. Dep. CFSTI.

Measurements were made of $D_\perp$ based on the volume plasma loss properties of a variable length, single-ended linear "Q" device. The experiment is designed to avoid complications arising from end-plate processes and ion loss to radially inserted probes. Single-ended refers to one hot ionizer plate and one cold reflector plate at floating potential with respect to the plasma. For the temperatures, densities, and magnetic field strengths of this experiment volume recombination is negligible, and the principal plasma loss is either by diffusion or by convective transport due to macro instabilities. The measurements were carried out both under quiescent conditions (plasma potential fluctuations $\lesssim 0.01$ kT) and in the presence of low frequency ($5\text{ kHz} \leq f \leq 50\text{ kHz}$) micro-instabilities with plasma potential fluctuations $\sim$kT. Abrupt changes in plasma loss from the column have been observed and appear to be associated with a transition from quiescence to a state characterized by low level micro-instabilities. (auth)

26353 (TID-24254) REPORT OF AD HOC PANEL ON FUSION RESEARCH ON LOW BETA PLASMAS CONFINED IN OPEN-ENDED MAGNETIC GEOMETRIES. Mar. 1968. 55p. Dep. CFSTI.

The committee reviewed the AEC open-ended low-beta plasma programs. Recommendations are discussed. (M.O.W.)

26354 (UCID-15305) HIGH-VACUUM TRAPPING EXPERIMENTS IN NEW ASTRON WITH RESISTORS. Beal, J. W.; Lamb, W. A. S. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 13, 1968. Contract W-7405-eng-48. 13p. Dep. CFSTI.

The survey was made by making variations of injection parameters and making observations of the distribution of the trapped beam and the total charge trapped. Variations were made of

(1) charge injected, (2) energy injected, and (3) pulse length injected. The pressure in Astron ranged from 2 to 4 × 10^{-6} torr. A separate series was run changing only the vacuum field configuration while leaving the other parameters unchanged. (M.O.W.)

26355 (UCRL-70841) ENHANCED ION CYCLOTRON RADIATION AND STABILIZING EFFECTS OF MICROWAVE HEATING IN THE ALICE MACHINE. Moses, K. G.; Damm, C. C.; Foote, J. H.; Futch, A. H. Jr.; Gardner, A. L.; Osher, J. E.; Post, R. F. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 20, 1968. Contract W-7405-eng-48. 34p. (CONF-680113-1). Dep. CFSTI.

From Conference on Interaction of Stationary and Progressive Electromagnetic Fields with a Plasma, Saclay, France.

The plasma contained in the quadrupole magnetic well of the Alice device is formed by Lorentz ionization of a highly excited atomic beam. The resulting particle distribution function is monoenergetic and highly anisotropic with respect to the pitch angle distribution about the field lines. Computer calculations, under single particle approximations, have shown that the average value of $E_\parallel/E_\perp$ is 0.1 for the present injection method and magnetic field configuration. The plasma thus formed is subject to high-frequency instabilities as characterized by rf emission at the ion gyrofrequency associated with the ejection of electrons out the mirrors. In addition, the instability limits the trapped ion density to a maximum value of 5 × 10^8 cm^{-3} under the present conditions. Attempts to quell these instabilities by resonant electron cyclotron heating by microwave radiation at 12.4 to 18 GHz (K_u-band) have produced periods of reduced unstable behavior with an increase of approximately 25% in trapped ion density. The frequency of the microwave power which produces the stabilizing effects is associated with magnetic field regions which are approximately 15% higher than the minimum magnetic field at the center of the plasma. Resonant heating at other field regions have produced enhanced rf activity at the ion cyclotron frequency. The stimulated bursts of ion cyclotron emission are accompanied by the ejection of electrons and slow ions through the mirrors. The results of these experiments have not as yet been theoretically explained. (auth)

26356 (NP-tr-1620) THE "SIRIUS" MAGNETIC TRAP WITH HELICAL FIELD. Biryukov, O. B.; Burchenko, P. Ya.; Vasilenko, B. T.; Volkov, E. D.; Georgievskii, A. B.; Loginov, A. S.; Nikolaev, R. M.; Sashenko, Yu. V.; Suprunenko, V. A.; Tolok, V. T. Translated for Culham Lab., Abingdon, Eng., from At. Energ. (USSR), 23: 92-102(Aug. 1967). 8p. (CTO-436). Dep. CFSTI. UK. JCL $1.10 fs, $0.80 mf.

An abstract from the original paper appeared previously in NSA 22: 7261. (M.O.W.)

26357 CONFINEMENT OF INJECTED PLASMAS IN STELLARATORS. Ellis, R. A. Jr.; Eubank, H. P. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Fluids, 11: 1109-14 (May 1968). (MATT-579).

Plasmas produced by a washer plasma gun have been injected into B-3, which is a twisted figure-eight stellarator, and Etude, which is a racetrack stellarator. Both have l = 3 helical windings. In the injected plasmas $n_e \leq 5 < 10^9$, $T_e \approx 5$ to 8 eV, and T_i is probably greater than T_e. The mean free paths for electron collisions were in the range 10 to 100 machine lengths. The observed confinement times varied with confining field as B^m with 0.6 < m < 1.2 for B ≤ 20 kG in B-3. In Etude, the confinement times varied from the Bohm value at zero rotational transform ι and increased by a factor 20 when ι = 5.43 Rad. In B-3 the confinement times varied from about twice the Bohm value when only the geometric transform was present and increased by a factor 30 when ι was increased to 19 Rad. It was not possible to decide if the increase of confinement time was due to effects of shear or rotational transform. (auth)

26358 INFLUENCE OF A TOROIDAL FIELD ON PLASMA CONFINED IN A TOROIDAL OCTUPOLE. Lencioni, D. E.; Poukey, J. W.; Schmidt, J. A.; Sprott, J. C.; Erickson, C. W. (Univ. of Wisconsin, Madison). Phys. Fluids, 11: 1115-25(May 1968). (COO-1233-51(Rev.)).

A toroidal magnetic field B_θ of up to 360 G was added to the Wisconsin toroidal octupole producing a stellarator-like field with a large rotational transform and large shear. The influence of this B_θ on plasma injection, transport, density distribution, lifetime, and electric-field fluctuations was studied. Injection and transport were not inhibited by B_θ and proceeded in much the same way as for $B_\theta = 0$. The density distribution after filling was unchanged and remained peaked slightly off the separatrix toward the hoops. The lifetime was smaller with E_θ, but was still consistent with expected losses to the hoop supports. In the originally V'' unstable region outside the last stable field line, the amplitude of the electric field fluctuations decreased when B_θ was added, but in the interior of the plasma, the fluctuations increased monotonically with B_θ. In the plasma interior the maximum diffusion coefficient derived from the fluctuations increased from 10^{-4} D_{Bohm} to 10^{-2} D_{Bohm} as B_θ was increased from zero to 140 G, but the observed lifetime, limited by hoop supports, was always ~10 τ_{Bohm}. Large potential deviations which were affected by magnetic field perturbations occurred in the region of zero average shear. Large external-field perturbations were added with no effect on the lifetime. Fluctuations associated with stable inverted density gradients were reduced or eliminated by B_θ. (auth)

26359 PLASMA CONTAINMENT AND STABILITY THEORY. Taylor, J. B. (Culham Lab., Abingdon, Eng.). Proc. Roy. Soc. (London), Ser. A, 304: 335-60(Apr. 23, 1968).

Models of the behavior of high-temperature plasma are applied to the problem of plasma confinement in magnetic traps. A wide variety of possible instabilities is disclosed. In magnetic mirror traps the low frequency instabilities can be overcome by design of the magnetic field. The high frequency instabilities, particularly those associated with the loss-cone character of the equilibrium distribution function, are more persistent and appear to impose severe restrictions on the dimensions of the plasma. Consequently toroidal traps seem to offer a better prospect for long-term containment but at present they are subject to low-frequency instabilities which persist even when conditions for hydromagnetic stability have been met. These instabilities may be due to small resistive effects or to an unstable drift wave. The resistive instabilities should disappear at high temperature and the drift-wave instability should be overcome by increased shear in the magnetic field. (auth) (UK)

26360 PLASMA HEATING IN THE TWO-STEP THETA PINCH. Gabovich, M. D.; Mitropan, I. M.; Priimachek, V. V. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 13: 488-91(Mar. 1968). (In Russian).

An investigation is carried out of the two-step theta pinch produced by two coaxial coils supplied by separate capacitor batteries. With the battery discharge on the external coil a hot deuterium plasma appears which is affected by the magnetic field of the internal coil. In such a theta pinch by means of a low-energy (6-kJ) capacitor battery one can obtain plasma heated to high temperatures. (auth)

26361 NONLINEAR EFFECTS IN A PLASMA STABILIZED BY THE CUTTING OF THE LINES OF THE MAGNETIC FIELD. Laval, Guy; Pellat, Rene; Khiet, Tu (EURATOM-CEA, Fontenay-aux-Roses, France. Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 161-4(Jan. 15, 1968). (In French).

It is shown that a weak cutting of the lines of force of the magnetic field causes a significant reduction of the diffusion coefficient of a confined plasma even in the absence of a total stabilization. Moreover, if the normal modes are stable, a finite amplitude perturbation can put the system in a turbulent state. (tr-auth)

26362 DENSE PLASMA AND NUCLEAR FUSION. Linhart, J. G. (EURATOM-CNEN, Frascati, Italy). Neue Tech., 9: 237-41(Dec. 1967).

The relation of present attempts at controlled thermonuclear fusion to Lawson's criteria is discussed. (M.O.W.)

26363 METHOD OF AND ARRANGEMENT FOR COMPRESSING AND HEATING ARC PLASMA. (to Fabrik Elektrischer Apparate Sprechier and Schuh AG). British Patent 1,110,061. Apr. 18, 1968. Priority date Apr. 17, 1964, United States.

The method is characterized in that a plasma column is produced between two electrodes by striking and maintenance of an electric arc and directing an operating medium in rotationally symmetric and radially concentric manner to a part of the length of this plasma column, the current strength of the arc being at least 10,000 A and the hydrodynamic pressure of the operating medium being at least 50 kg/cm^2. (M.O.W.)

Diagnostics of Plasma

26364 (LA-tr-67-113) NEUTRONS FROM d-d-REACTIONS AS A TOOL FOR PLASMA DIAGNOSTICS. Lehner, G.; Pohl, F. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Translated by A. D. Cernicek (Los Alamos Scientific Lab., N. Mex.), from report IPP-1/60. 43p. Dep. CFSTI. JCL $4.60 fs, $1.52 mf.

An abstract from the original report appeared in NSA 21: 35145. (M.O.W.)

26365 SOME MEASUREMENTS ON A HYDROGEN PLASMA IN A MAGNETIC WELL. Cilliers, W. A. (Langley Research Center, Hampton, Va.); Driver, H. S. T. Phys. Fluids, 11: 1056-60(May 1968).

The behavior of a hydrogen plasma inside a coil which gives a vacuum magnetic field with minimum |B| properties, has been studied in some detail. Streak and framing pictures were taken and the variation of electron density with time was measured. During the first half-cycle of the coil current, the plasma appeared to be stable. The experiment was carried out at relatively low energy. For purposes of comparison, a theta pinch was studied using the same capacitor bank. (auth)

26366 DEPOLARIZATION OF LIGHT SCATTERED BY A RELATIVISTIC PLASMA. Theimer, O.; Hicks, W. (New Mexico State Univ., Las Cruces). Phys. Fluids, 11: 1045-7 (May 1968).

The depolarization ratio ρ for the single particle light scattering spectrum of a relativistic plasma with a displaced Maxwell velocity distribution is calculated to the lowest significant order in $\beta = v/c$. (c is the light velocity; v is the electron velocity.) It is found that ρ reaches the order of magnitude 0.1 if the temperature increases beyond 10^8°K, and that the plasma temperature can be determined by one single polarization measurement without spectral decomposition of the scattered radiation. (auth)

26367 USE OF LANGMUIR PROBES IN LOW-PRESSURE RARE GAS PLASMAS. Hart, D. A.; Oleson, N. L. (Naval Postgraduate School, Monterey, Calif.). Phys. Fluids, 11: 1101-3(May 1968).

Evidence is presented which indicates that the assumption of zero ion energy yields best agreement between the results of probes and other methods for charge densities in the range of 10^9 to 10^{11} cm^{-3} in a xenon discharge of several mtorr. (auth)

26368 MEASUREMENT OF θ-PINCH END LOSS USING A GAS LASER INTERFEROMETER. Thomas, K. S. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 11: 1125-8(May 1968).

A He–Ne gas laser interferometer has been used to make plasma density measurements outside the central plasma core of a θ-pinch plasma. At the θ-pinch coil midplane, the average plasma density is less than the sensitivity of the interferometer, that is, less than 5×10^{13} cm^{-3}. Outside the ends of the coil line densities (particles per cm of tube length) of the order of 10^{15} cm^{-1} are measured. When compared with previous data from the same θ pinch, a streaming velocity out the coil ends in the neighborhood of the ion thermal velocity is obtained. (auth)

26369 MICROWAVE ELECTRON DENSITY PROBE. Abele, Manlio; Medecki, Hector; Attwood, David (General Applied Science Labs, Inc., Westbury, N. Y.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 901-6(May 1968).

An electron density probe whose operation is based upon the interaction between plasma and the electromagnetic field of an open, nonradiating microwave structure is presented. The resonant properties of the structure are related to those of the plasma. The probe is capable of measuring electron densities both above and below the critical value. In particular, a probe operating in the 3-cm wavelength range is presented whose range of measurable electron densities extends from 10^{10} to 10^{14} e/cm^3. (auth)

26370 SELF-LUMINOSITY OF A BARIUM Q-PLASMA. Motz, R. O. (Stevens Inst. of Tech., Hoboken, N. J.). Contract AT(30-1)-2813. J. Quant. Spectrosc. Radiative Transfer, 8: 961-70(Mar. 1968). (SIT-2813-42).

A steady-state, non-LTE barium plasma, as produced in a Q machine, is examined theoretically to determine under what conditions the electron kinetic temperature can be calculated if the intensity of the emitted resonance radiation is known. It is shown that, if the plasma particle density exceeds 10^{10} cm^{-3}, the steady-state corona model is no longer applicable and the electron temperature cannot be determined without a knowledge of the local energy density of resonance radiation, i.e., without solving the equation of radiative transfer for the plasma. (auth) (UK)

26371 MICROWAVE CAVITY STUDIES OF IONIZATION DECAY IN CAESIUM VAPOUR. Harris, J. H.; Balfour, D. (International Research and Development Co., Ltd., Newcastle-upon-Tyne, Eng.). J. Phys., D, 1: 409-23(Apr. 1968).

The microwave cavity technique for measuring electron concentration is considered, an experimental study of the effects of holes in the cavity on the field distribution in the cavity is reported and a method is described which enables the relationship between electron concentration and frequency change to be established empirically. A method for continuously monitoring the frequency changes due to ionization is described, and the effect of electron collisions is treated theoretically. A technique allowing instantaneous measurements of electron concentration and rate of decay of concentration is described. The decay of ionization in afterglows in cesium vapor was studied, giving recombination coefficients which varied with pressure from about 0.3×10^{-6} cm^3 s^{-1} at 0.5 torr to about 2×10^{-6} cm^3 s^{-1} at 3 torr, consistent with a dissociative process. At late stages in afterglows, where diffusion loss dominates, estimates of reduced mobilities of diffusing ions suggest that at 0.1 torr the Cs^+ ion dominates, whereas at pressures of about 10 torr the Cs_2^+ ion is more important. Measurements of electron collision frequency as a function of vapor pressure between 0.1 and 4 torr are reported. (auth) (UK)

26372 AN INVESTIGATION OF BOUNDARY THEORIES FOR THE RESONANCE PROBE. Kostelnicek, R. J. (Univ. of Illinois, Urbana). Radio Sci., 3: 319-24(Apr. 1968).

A formula for the admittance of a spherical probe in a warm collisional homogeneous plasma is derived using a step ion sheath with complete electron reflection at the sheath-plasma interface. The resulting equations for the perturbations in sheath voltage and number density at the interface are related to the resonance probe phenomenon. Laboratory measurements displayed the effect of sheath thickness on the resonance probe characteristic. The rigid boundary theory is experimentally shown to break down at sheath collapse, comparing a suitable absorptive boundary theory with the experiment. (auth)

26373 RADIATION OPERATOR IN NONEQUILIBRIUM PLASMAS. Solbes, Albert (Massachusetts Inst. of Tech., Cambridge). Contract DA28-043-AMC-02536(E). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 737-9(Apr. 1968).

An exact analytical method for performing the angular and frequency integrations for any arbitrary electron temperature distributions is provided, within the limit of the simplifying physical assumptions of Lutz. The resulting expression for the radiant energy loss involves only a single spatial integration. (M.H.R.)

26374 MEASUREMENT OF PLASMA TEMPERATURE USING A WAVEGUIDE PROBE. Aro, T. O.; Walsh, D. (Oxford Univ.). Phys. Fluids, 11: 1070-6(May 1968).

The central portion of the plasma produced in a shock tube was sampled by allowing it to flow into a length of x-band rectangular waveguide, coaxial with the shock tube. The temperature of the portion of ionized gas inside the waveguide was determined from the measurement of the microwave noise emitted by the shock-heated gas and its absorption coefficient measured at the same frequency, 9.05 Gc/sec. The measured temperatures were between 4700 and 6000°K for shocks of Mach numbers between 7.0 and 10.6 in argon at an initial pressure of 4 mm Hg. The selection of the middle axial portion of the shock eliminates the boundary layer present at the walls of the shock tube. (auth)

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Refer also to abstracts 26126, 26238, and 26298.

26375 (BNL–10300) STOPPING POWER OF A FREE ELECTRON GAS: CONTRIBUTIONS FROM COLLECTIVE AND SINGLE-PARTICLE EXCITATIONS. Erginsoy, Cavid (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(30-2)-Gen-16. 9p. Dep. CFSTI.

The stopping power of a degenerate electron gas for a fast heavy particle was investigated. Contributions from plasma excitations and from single-particle excitations were evaluated separately for finite particle velocities and finite gas densities. (M.O.W.)

26376 (D–1–82–0709) ALFVEN WAVES IN RELATIVISTIC PLASMAS. Hoh, F. C. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Feb. 1968. 17p.

Expressions for Alfvén waves, its Landau damping, and magnetosonic waves are derived in a homogeneous relativistic Vlasov plasma. Relativistic effects reduce the speed of both waves. (auth)

26377 (NP–17429) THEORY OF THE GENERATION OF WAVES IN A PLASMA DESCRIBED BY A DIELECTRIC TENSOR. Rijnhuizen Report 67-42. Bremmer, H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fyzica). Sept. 1967. 11p. Dep.

A relation is derived for the computation of the electric field generated by a given distribution of currents in an unbounded homogeneous plasma, characterized by a dielectric tensor. In its simplest form the relation determines the electric field resulting from a single plane-wave distribution of the source currents. The simultaneous generation of both longitudinal and transverse waves is discussed. The general theory is illustrated by the example of the disturbance produced by an infinitesimal current element embedded in an unbounded space with an infinite homogeneous magnetic field. (auth)

26378 (NP–17435) BIBLIOGRAPHY ON GAS DISCHARGES IN CROSSED FIELDS. Rijnhuizen Report 67-43. Schuurman, W.; Diemer, W. (Stichting voor Fundamenteel Onderzoek der

Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Sept. 1967. 40p. Dep.

A listing is presented of 278 articles dealing with Penning discharges, magnetron discharges, and various properties of charged layers in crossed fields. (M.O.W.)

26379 (NP-17436) PROPAGATION OF COMPRESSIONAL AND TORSIONAL ALFVEN WAVES UNDER IDENTICAL PLASMA CONDITIONS. Cross, R. C.; Lehane, J. A. (Sydney Univ., (Australia). School of Physics). Feb. 1968. 15p. (ER-38). Dep.

Though many authors have separately studied torsional and compressional Alfvén waves, no measurements made on both waves for the same plasma conditions have been reported. This paper presents such measurements for several different sets of plasma conditions. For each set of conditions, velocity and attenuation measurements were made for each wave and by comparing with theoretical curves, the values of the various parameters determining the wave propagation were obtained. The compressional and torsional wave measurements gave independent estimates of the parameters. The two sets of parameters show a broad agreement which is particularly significant since decoupling of the ions from the neutrals is taking place over the frequency range for which the measurements were made. The torsional wave measurements do, however, imply a higher total density and lower percentage ionization than the compressional wave measurements. The existence of this difference implies that nonuniformity of the radial density distribution is effecting the wave propagation. (auth)

26380 (NP-17437) COMPRESSIONAL ALFVEN WAVE PROPAGATION BELOW ION CYCLOTRON FREQUENCY. Cross, R. C.; Lehane, J. A. (Sydney Univ. (Australia). School of Physics). Feb. 1968. 26p. (ER-37). Dep.

When the compressional wave cutoff frequently is below ion cyclotron frequency, both compressional and torsional Alfvén waves may be present simultaneously. Compressional wave measurements in this regime are particularly important because of the relevance they have to certain ion cyclotron resonance heating experiments. The measurements deal mainly with the dispersion of the azimuthally symmetric wave and the radial variation of its magnetic field components. The observed radial variation agrees with that expected theoretically as does the change in the relative amplitudes of the field components with frequency. The dispersion relation measurements, made in a decaying plasma, yield values of the plasma parameters which change with time after breakdown in a way consistent with spectroscopic observations. These measurements bring out the importance of ion-neutral coupling and yield a value of the ion-neutral momentum transfer cross section of $(7.5 \pm 2.5) \times 10^{-15}$ cm^2, which is consistent with estimates made from torsional wave studies. (auth)

26381 (NP-17439) OBSERVATIONS OF CURRENT-INDUCED ANOMALOUS BEHAVIOUR IN A CYLINDRICAL PLASMA COLUMN. Hooker, C. A.; Sharp, L. E. (Sydney Univ. (Australia). School of Physics). Nov. 1967. 22p. (ER-32). Dep.

Studies were made of a weakly ionized (≤10%), "cool" (<1 eV) cylindrical plasma column when it is subjected to an applied axial current. Under these conditions there exists a critical range of axial current values within which the plasma exhibits an enhanced decay rate, a reduced effective axial resistance and a rotating helical structure. This range of currents for which anomalous behavior occurs has well-defined upper and lower limits. The dependence on plasma parameters of the effective enhanced decay rate, and, to a lesser extent, of the extremes of the critical current range, have been examined. (M.O.W.)

26382 (SC-R-68-1691) SCATTERING FROM IMPERFECTLY CONDUCTING SPHERES: THEORETICAL CONSIDERATIONS. Harrison, Charles W. Jr. (Sandia Corp., Albuquerque, N. Mex.). Jan. 1968. Contract AT(29-1)-789. 29p. Dep. CFSTI.

Scattering from imperfectly conducting spheres having both positive and negative dielectric constants is treated theoretically in a rigorous manner. (auth)

26383 (SC-R-68-1692) SCATTERING FROM IMPERFECTLY CONDUCTING SPHERES: NUMERICAL RESULTS. Harrison, Charles W. Jr.; Houston, Margaret K. (Sandia Corp., Albuquerque, N. Mex.). Jan. 1968. Contract AT(29-1)-789. 40p. Dep. CFSTI.

Numerical results are presented based on a rigorous theory of scattering from imperfectly conducting spheres having positive and negative dielectric constants. (auth)

26384 (SU-IPR-205) CYCLOTRON HARMONIC WAVE PROPAGATION AND INSTABILITIES. Tataronis, J. S. (Stanford Univ., Calif. Inst. for Plasma Research). Dec. 1967. Contract AT(04-3)-326. 179p. Dep. CFSTI.

A theoretical study was made of the electrostatic space-charge waves which propagate in a hot plasma immersed in a constant and uniform magnetic field. It is based on the self-consistent solution of the collisionless Boltzmann equation with Poisson's equation in infinite planar geometry and is restricted to interactions which involve only electrons. By considering a series of velocity distributions $f_0(v)$, a clear and comprehensive picture of the propagation characteristics and stability properties of these waves has been obtained. The frequency and wave number of the normal modes are connected through a dispersion relation which has been solved here, and the results are displayed in both graphical and analytical forms. For perpendicular propagation a mode is found near each harmonic of the electron cyclotron frequency. If $(\partial f_0/\partial v_\perp) > 0$ for some range of the velocity component perpendicular to the magnetic field, $v_\perp$, it is shown that these modes can couple to form regions in the dispersion diagram where complex frequencies exist with negative imaginary part and real wave number, indicating that the plasma supports space-charge waves which grow with time. The exact threshold conditions for these instabilities are derived for several distributions, and the growth rates are computed as a function of the electron density. However, if $(\partial f_0/\partial v_\perp) < 0$ for all $v_\perp > 0$ or if the electron density is sufficiently low, the propagation in this direction can occur without growth or collisionless damping; this suggests that, experimentally, excitation and detection of these waves should be readily attainable. When electron-neutral collisions are taken into account, the results show that for collision frequencies much less than the electron cyclotron frequency, damping is significant only at points on the dispersion curves where the group velocity vanishes. The results of the investigation of oblique propagation reveal two classes of normal modes, one of which has no counterpart in the case of purely perpendicular propagation. This leads to a new set of instabilities that are characterized by (1) onset conditions that are much less stringent than that of perpendicular propagation, and (2) growth rates that are strongly dependent on T, the ratio of the electron temperature perpendicular and parallel to the magnetic field. In the limit of an isotropic Maxwellian velocity distribution, T = 1 and all obliquely propagating modes decay with time as a result of Landau and cyclotron damping. Finally, a study has been made on the analyticity of the Laplace transform of the electrostatic Green's function. This leads to (1) a classification of the space-charge instabilities as either absolute or convective, and (2) a prediction of resonances at harmonics of the electron cyclotron frequency, at the cold-plasma upper hybrid frequency, and at intermediate frequencies between succeeding harmonics. The results show that instabilities associated with perpendicular propagation are absolute, while oblique propagation can support either absolute or convective instabilities, depending on the electron density and the distribution in electron velocity. (auth)

26385 (SU-IPR-226) ION WAVES, DRIFT WAVES AND INSTABILITIES ON A DISCHARGE COLUMN. Ewald, Harry Newcomb (Stanford Univ., Calif. Inst. for Plasma Research). Mar. 1968. Contract AT(04-3)-326. 124p. Dep. CFSTI.

A theory for the positive column of a weakly ionized gas discharge is derived from the first two moments of the Boltzmann equation which is valid in the pressure range where the mean free path for ion-neutral collisions is comparable to, or less than, the discharge tube radius. The electron motion is assumed to be collision-dominated. In the steady state, the theory predicts correctly the experimentally observed dependence of the electron-neutral ionizing collision rate on pressure, and the dependence of the radial charged particle density and potential profiles on magnetic field. A small signal linear analysis is presented which successfully predicts the propagation characteristics of the normal ion acoustic wave and, for the first time, predicts the existence of the electron drift wave mode which has been observed experimentally. The analysis is for an inhomogeneous plasma in which the steady state mean radial velocity profiles are included in the perturbation solution. As the magnetic field is increased, a condition of instability is observed in the laboratory, and also predicted from the small-signal theory. The mechanism of the instability is identified as the low pressure equivalent of the unstable helical mode first studied by Kadomtsev and Nedospasov. (auth)

26386 QUANTUM MECHANICAL BINARY DISTRIBUTION FUNCTION AND CORRELATION ENERGY OF HIGH-TEMPERATURE PLASMAS. Kremp, D.; Kraeft, W. D. (Univ., Rostock, Ger.). Ann. Phys. (Leipzig) (7), 20: 340-7(1968). (In German).

If a quantum mechanical potential is introduced the calculation of the quantum mechanical binary distribution function for a system with Coulomb interaction is reduced to the well-known mathematical formalism of classical mechanics in the case $n\lambda^3 \ll 1$. The two-particle quantum mechanical potential is determined by

the two-particle Slater sum. The two-particle Slater sum was calculated using a development according to e^2 and the resolvent formalism. From the binary distribution function the correlation energy as well as the free energy were determined up to the order e^4. Symmetry effects were taken into account. (auth)

26387 MICROWAVE BURST AT TRIGGERED INSTABILITY IN A HOT ELECTRON PLASMA. Ikegami, H.; Ikezi, H.; Hosokawa, M.; Takayama, K.; Tanaka, S. (Nagoya Univ., Japan). Phys. Fluids, 11: 1061-4(May 1968). (IPPJ-59).

A hot electron plasma is produced in a magnetic-mirror field by high-power microwave discharges. When an instability is triggered in a hot electron plasma, it is observed that the instability is accompanied by a burst of energetic electrons escaping from the magnetic mirror, a fast rising x-ray signal, a sudden increase of light intensity, and an intense burst of microwaves composed of harmonics of 2.1 GHz. This frequency cannot be explained in terms of the electron cyclotron frequencies associated with the magnetic field intensity within the plasma chamber. (auth)

26388 FREE–FREE BREMSSTRAHLUNG FROM A PLASMA WITH AN ANISOTROPIC ELECTRON VELOCITY DISTRIBUTION. Shohet, J. L. (Univ. of Wisconsin, Madison). Contract AT(11-1)-1695. Phys. Fluids, 11: 1065-70(May 1968). (COO-1695-8).

Measurements of two properties of the emitted free–free bremsstrahlung from an electron cyclotron resonance plasma were made. These were the radiation intensity and the spatial distribution of the photons as a function of angle with respect to the magnetic field axis. The intensity was maximum for directions of observation along the field lines. The spectral distribution showed that the average emitted x-ray photon was more energetic along the field lines than across them. A theoretical development has been made which considers quantum-mechanical, nonrelativistic transitions, which correspond to the conditions of the experiment. The theory predicts the observed measurements and also, in the limit of low energy photons, (nonquantum mechanical transitions) corresponds to previous developments. (auth)

26389 PLASMA WAVES AND ROTATION IN THE GAS-FED HOLLOW-CATHODE ARC. Kretschmer, C. B.; Boeschoten, F.; Demeter, L. J. (Aerojet-General Corp., San Ramon, Calif.). Phys. Fluids, 11: 1050-6(May 1968).

Mass rotation and azimuthally propagating waves have been observed in gas-fed hollow-cathode arcs having $n_e \approx 10^{14}$ cm^{-3}, $T_e \approx 1$ eV, $T_i = 3$ to 30 eV, and $B_z = 1$ to 6 kG. The column rotates as a rigid body at an angular velocity of $\frac{1}{2}\omega_{ci}$; it is shown theoretically that at this velocity the radial density gradient has the maximum value at which equilibrium is possible in the absence of a radial electric field. This maximum gradient corresponds to an $\exp[-r^2/(2\rho_i)^2]$ dependence of density on radius, where ρ_i is the ion Larmor radius. The observed waves propagate in the electron drift direction exactly perpendicular to the axis of the arc, but have nonzero $k_\parallel$ because of the azimuthal field of the arc current. They are identified as resistively unstable drift waves, modified torsional Alfvén waves, and ion cyclotron waves. The drift and ion cyclotron waves occur as coherent oscillations with phase-locked harmonics, while the Alfvén waves are noncoherent. Because of the dependence of the density gradient on B_z, the drift wave frequency is proportional to B_z and the Alfvén wave frequency is independent of B_z. The Alfvén and ion cyclotron waves are excited by a feedback mechanism involving electron flow across the anode sheath. (auth)

26390 FUNDAMENTAL SOLUTION FOR THE LINEARIZED GUIDING-CENTER EQUATIONS. Kadish, Abraham (Univ. of Wisconsin, Madison). Phys. Fluids, 11: 1031-5(May 1968).

The linear one-dimensional propagation of an initial perturbation in an infinite, homogeneous, stable guiding-center plasma is studied. The dominant mode of decay after long periods of time is shown to be that of a reciprocal power of time. (auth)

26391 SOLUTION OF THE LINEARIZED VLASOV EQUATION FOR A SPACE–TIME-DEPENDENT DISTRIBUTION FUNCTION. Bloomberg, H. (FOM-Instituut voor Plasma-Fysica Rijnhuizen, Jutphaas, Netherlands). Phys. Fluids, 11: 1023-30(May 1968).

A solution is given for the one-dimensional linearized Vlasov equation when the background distribution function f_0 is a sufficiently weak function of space and time; the field is given self-consistently through the Poisson equation and the initial value problem is explicitly considered. An eikonal solution, common to geometrical optics, is found, and the appropriate combination of such solutions so as to conform to given initial conditions is specified. Results are given for the modification of the Landau damping through the variation of f_0, as well as for the coefficient of the eikonal exponential, which change is directly due to the space–time variation of f_0. An example is given for an eikonal wave, in which wave–particle energy transfer is initially small, which is "driven" through the change of f_0 to a condition where the solution breaks down due either to strong wave–particle effects or to the invalidity of the basic eikonal ordering assumption. Estimates for the times at which these limiting effects occur are given. (auth)

26392 CLASSICAL DIFFUSION LIMIT OF ONE-DIMENSIONAL HYDROMAGNETIC FLOW. Bineau, M. (New York Univ., N. Y.). Phys. Fluids, 11: 1020-2(May 1968).

The hydromagnetic flow of a plane sheet of plasma with scalar pressure is represented by a set of equations for which the Cauchy problem is well posed. If the Alfvén speed is made infinite in this system with dimensionless variables, one obtains the classical diffusion limit. The velocity of diffusion is then defined purely by boundary conditions at each time. (auth)

26393 DISPERSION RELATIONS IN RELATIVISTIC VLASOV PLASMAS. Prentice, A. J. R. (Univ. of Melbourne). Phys. Fluids, 11: 1036-44(May 1968).

The complete solution, for all temperatures and wave numbers, of the longitudinal and transverse dispersion equations of a relativistic Maxwellian plasma, is presented. It is assumed that the ions are immobile and that there is no zero-order magnetic field. Analytical methods are used for the very small and very large wave number cases, and in the intractable intermediate wave number regions numerical results are displayed graphically. The existence at all temperatures of very slightly damped longitudinal plasma waves and slightly damped nonoscillatory transverse excitations is established and the damping constants are evaluated. Necessary and sufficient conditions for the existence of slight Landau damping of longitudinal plasma waves in any general isotropic relativistic Vlasov plasma are also derived. Several new dispersion relations for undamped oscillations, which have phase velocity greater than c, are recorded. One of these, which describes transverse oscillations for large wave numbers, corresponds to the propagation of light waves in the plasma. (auth)

26394 ABSORPTION IN A HOT PLASMA NEAR THE SECOND HARMONIC OF THE ELECTRON CYCLOTRON FREQUENCY. Arunasalam, V.; Meservey, E. B.; Gurnee, M. N.; Davidson, R. C. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Fluids, 11: 1076-84(May 1968). (MATT-534).

Analysis is presented of 4-mm microwave propagation in the extraordinary mode (for propagation angles of 76, 90, and 104° to the external magnetic field), near the second harmonic of the electron cyclotron frequency, across reasonably uniform, highly ionized cylindrical plasma columns (approximately 3, 4, and 5 in. in diameter) confined in a homogeneous (0.05%) magnetic field in the Model C stellarator. Reasonably good agreement with the general predictions of the conventional collisionless hot-plasma theory is obtained. In particular, the measured values of the width, the depth, and the strength of the experimentally detected absorption resonances fall within ±50% of the corresponding theoretically expected values. For these experiments the electron densities are typically in the range of 10^{11} to 10^{13} per cm^3; the electron temperatures are in the range of 5 to 35 eV; and the electron collision frequencies ν are such that $\nu/\omega \lesssim 5 \times 10^{-5}$, where ω is the angular frequency of the incident microwave beam. (auth)

26395 STATIONARY EQUILIBRIUM OF A TOROIDAL PLASMA. Viswanathan, K. S. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Fluids, 11: 1104-8(May 1968). (MATT-557).

Studies are made of the effects of resistivity, inertial forces, viscosity, pressure anisotropy, and especially gyroviscosity on the stationary equilibrium of a low-density plasma in toroidal geometry. The conditions imposed by viscosity on the two arbitrary functions occurring in the expression for the zero-order velocity vector have been derived. It is shown that gyroviscosity does not impose conditions on these two arbitrary functions. It is suggested that among the perturbing forces considered, dissipative forces such as the collision-dominated viscosity and resistivity will give rise to conditions on the two arbitrary functions at the higher approximations. (auth)

26396 INTERACTION OF A CHARGED PARTICLE WITH MOVING CURRENT LAYER. Kulinski, S. (Inst. of Nuclear Research, Warsaw). Phys. Fluids, 11: 1133-5(May 1968).

The equations of motion for a charged particle overtaken by a moving current layer are written and solved. It is shown that a particle can (a) be reflected by the layer, (b) be captured by it, and (c) penetrate through the layer. (auth)

26397 SHOCK-WAVE STRUCTURE IN THE WEAKLY IONIZED PLASMA. Muraoka, Katsunori; Ikui, Takefumi (Kyushu Univ., Fukuoka). Phys. Fluids, 11: 1129-31(May 1968).

The problem of the shock-wave structure in weakly ionized plasma is treated from the viewpoint of Mott–Smith approach,

the result being compared with the previously obtained experimental data and with the solution using Navier–Stokes equation. (auth)

26398 CURRENT SHEET DYNAMICS IN AN INVERSE PINCH SHOCK TUBE. Sorrell, F. Y. Jr. (California Inst. of Tech., Pasadena). Phys. Fluids, 11: 993-1001(May 1968).

Experiments were performed in argon, helium, and hydrogen in an inverse pinch electromagnetic shock tube. The current sheet and shock wave trajectories were measured by using magnetic pickup coils and piezoelectric pressure probes, respectively, and the electron number density was determined from electrostatic probes and by using the Stark broadening effect on spectral lines. The experimental parameters vary from conditions where the dominant heating mechanism in Ohmic dissipation to those where shock heating is greater. Snowplow speed for the current sheet is measured in all cases and low levels of ionization within the sheet were observed for the conditions where Ohmic dissipation was the only heating mechanism. A description of how a current sheet with a low degree of ionization can sweep up the gas it encounters (snowplow) is given. (auth)

26399 ELECTRIC FIELD AHEAD OF NORMAL IONIZING SHOCK WAVES. Cross, R. C. (Univ. of Sydney). Phys. Fluids, 11: 985-6(May 1968).

Measurements of the transverse electric field ahead of a normal ionizing shock wave are presented for Alfvén Mach numbers in excess of the ideal-gas limit of two. A simple expression is derived to explain the results. (auth)

26400 EXPERIMENTAL STUDY OF CYLINDRICAL MAGNETOHYDRODYNAMIC BLAST WAVES. Vlases, George C. (Environmental Science Services Administration, Boulder, Colo. Univ. of Colorado, Boulder); Jones, Donald L. Phys. Fluids, 11: 987-92(May 1968).

The interaction of a cylindrical ionizing blast wave with a uniform axial magnetic field is studied under conditions such that the magnetic Reynolds number is very small and the interaction parameter is of the order of unity. The source of the blast wave is an inverse pinch operating in the mode where the energy deposition time is short compared with the time required for the shock to traverse the chamber. The flow consists of an ordinary shock followed by ionized gas which interacts with the magnetic field to alter the trajectory and flow-field profiles from those given by the classical theory. Piezoelectric probe measurements show that while the shock is slowed by the magnetic field, the classical similarity is preserved, i.e., $R_{shock} \sim t^{\frac{2}{3}}$. Static pressure measurements indicate that in a magnetic field, p/p_{shock} rises rapidly behind the shock in direct contrast to the classical behavior. A mapping of the magnetic field indicates that large perturbations are found only near the axis and last only for short times. These results are in qualitative agreement with those predicted theoretically by Lykoudis in the limit of small magnetic Reynolds number. (auth)

26401 HIGH-TEMPERATURE THERMAL CONDUCTIVITY OF ARGON. Fay, James A.; Arnoldi, Douglas (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 11: 983-5(May 1968).

Measurement of shock-tube end-wall heat transfer shows a secular change at long time which is ascribed to variation of gage thermal conductivity with depth. (auth)

26402 STRUCTURE OF WEAK SHOCK WAVES IN A FULLY IONIZED GAS. Li, Huon (General Electric Co., Philadelphia); Mathieu, Richard D. pp 129-61 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

The effect of electrical charge separation on the structure of weak shock waves in a fully ionized plasma is investigated using a macroscopic two-fluid theory. The detailed features of the flow are obtained in terms of the number density, velocity, pressure, and temperature of the ions and electrons. The phenomenon of charge separation gives rise to an induced electric field. It is shown that the fluid properties of the ions and electrons vary in an oscillatory manner through the shock wave for small values of the mean free path–Debye length parameter. As the mean free path between particles decreases, the oscillations damp out more rapidly and at the same time the oscillations become less frequent. For extremely small values the mean free path–Debye length parameter, the plasma properties exhibit an aperiodic variation through the shock wave. The Debye length is shown to be the important characteristic length. The initial change or oscillation in the induced field occurs in 10–12 Debye lengths for both the oscillatory and aperiodic cases. (auth)

26403 PLANE WAVES IN A MAGNETOIONIC MEDIUM. Seshadri, S. R. (Univ. of Wisconsin, Madison). Electron. Lett., 4: 121-2(Apr. 5, 1968).

With a view to elucidating the difficulties inherent in the treatment of wave propagation in a magnetoionic medium in terms of homogeneous plane waves, the theory of homogeneous plane waves in such a medium is reviewed with particular emphasis on the properties of the time-averaged Poynting vector. (auth) (UK)

26404 ELECTROMAGNETIC WAVE AMPLIFICATION BY CHARGED PARTICLE FLOW FOR TRANSIENT RADIATION IN AN INHOMOGENEOUS MAGNETOACTIVE MEDIUM. Fainshtein, S. M. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 217-23(1968). (In Russian).

Electromagnetic wave amplification by a particle flow piercing the interface of two magnetoactive media is considered. The energy of electromagnetic waves radiated by a particle moving along a screw line in a magnetoactive plasma in the direction of a constant magnetic field is calculated. It is shown that an effective interaction of waves with the charged particle flow is possible under definite conditions. Consideration is made by means of the Einstein coefficient method. (auth)

26405 SCATTERING OF LOW-FREQUENCY LONGITUDINAL WAVES ON CHARGED PARTICLES IN MAGNETOACTIVE PLASMA. Tavdgiridze, T. L. (Inst. of Physics, Tbilisi, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 209-16(1968). (In Russian).

Radiation of a charge moving in a magnetoactive plasma with low-frequency longitudinal oscillations excited is considered. The energy losses of the charge in a nonisothermal plasma are estimated. The problem of charged-particle acceleration in a weakly turbulent plasma is discussed. (auth)

26406 EXPERIMENTAL OBSERVATION OF NONLINEAR COUPLING BETWEEN SLOW AND FAST WAVES IN A PLASMA WAVEGUIDE. Hedvall, P. (Royal Inst. of Tech., Stockholm, Research Inst. of National Defence, Stockholm). Ark. Fys., 35: 283-6(1968).

Nonlinear coupling between slow and fast waves in a circular waveguide partially filled with a plasma were studied experimentally. The waveguide was short-circuited to form a resonant cavity. A slow, symmetrical wave was launched on the plasma column and propagated into the cavity. By feeding pump power into the TM_{010} resonant mode of the cavity a nonlinear coupling between the slow wave and the TM_{011} resonant mode could be achieved when the frequency of the slow wave was equal to the frequency difference between the two resonant modes. With a pump power of 1 watt an overall coupling coefficient of the order of –40 dB was obtained. (auth) (Swed)

26407 MATHEMATICAL ASPECTS OF CLASSICAL RELATIVISTIC STATISTICAL MECHANICS. Balescu, R.; Baus, M.; Pytte, A. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg., 53: 1043-69(1967).

The following questions are discussed: (1) The statistical description of the electromagnetic field and the concept of a distribution functional; (2) The canonical realization of the Poincaré group for a free field—it is shown in particular that the known generators are valid only in an infinite volume, and that the microscopic potential transforms as a 4-vector only in an infinite volume; (3) The choice of the variables which lead to the simplest properties of the Liouville operators; and (4) The explicit expressions for the Liouville operators both in phase space and in Fourier space are derived and listed in great detail. (auth)

26408 EFFECT OF AN ELECTRIC FIELD ON A WEAKLY IONIZED GAS. I. INFLUENCE OF INELASTIC COLLISIONS ON THE ISOTROPIC DISTRIBUTION FUNCTION: ASYMPTOTIC BEHAVIOR. Peyraud, Nelly (Faculte des Sciences, Orsay, France). J. Phys. (Paris), 29: 201-11(Feb.-Mar. 1968). (In French).

A homogeneous plasma, weakly ionized and optically thin for all transitions, is considered. The electron distribution function resulting from the balance between heating by a static electric field and losses by elastic and inelastic collisions on neutral molecules with n excitation levels is examined. An analytic method is given for obtaining the isotropic distribution function for energies higher than the upper threshold, when the cross sections for elastic and inelastic collisions are described by a simple diagram, the validity of which is discussed. (auth)

26409 REACTIVE EQUILIBRIUM OF MAGNETOACTIVE PLASMA. Wilhelm, H. E. (Univ. of Florida, Gainesville). Z. Phys., 211: No. 4, 389-90(1968).

A statistical theory of the ionization–recombination equilibrium of a nondegenerate plasma in a homogeneous magnetic field is

given. It is shown that the magnetic field changes the reactive composition if the quanta of the oscillatory electron motion in the magnetic field—which corresponds classically to the electron gyration—are of the order of or larger than the thermal energy, $\hbar\omega \gtrsim kT$. The ionization may be enhanced or depressed depending on whether the background gas of the plasma in diamagnetic or paramagnetic. Some low temperature experiments, where such an anomalous "magnetic ionization" might be observable, are discussed briefly. (auth)

26410 ELEMENTARY THEORY OF TRANSPORT PHENOMENA ACROSS A STRONG MAGNETIC FIELD IN A PLASMA. Aono, O.; Kaneko, S. (Univ., Tokyo). pp 203-9 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

A charged particle in a strong magnetic field is assumed to gyrate many times during a time interval between successive collisions. Physical quantities of the particle such as charge, momentum, and energy are thought to be located at the position of its guiding center, and the distribution functions are Maxwellian with respect to the position of the guiding center. Collisions move the guiding center across the field, causing a transport. The electrical and thermal conductivities, diffusion coefficients, and viscosities obtained in this elementary way agree exactly with those calculated by using the Boltzmann equation. (auth)

26411 THERMODYNAMIC PROPERTIES OF DILUTE ALKALI METAL PLASMAS. Milligan, J. H. Jr.; Liley, P. E. (Purdue Univ., West Lafayette, Ind.). pp 210-21 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

Assuming the alkali metals to exist as equilibrium mixtures of dimer, atom, singly ionized or doubly ionized atom and electrons, values of V, $-G/RT_0$, H/RT_0, S/R and C_p/R are given for lithium, sodium, potassium, rubidium, and cesium for most of the range 2,000 to 25,000°K, 10^{-4} to 10^{+2} atm. (A few values have been omitted for conditions where the Debye–Huckel theory was invalid.) The basic procedure used to compute the thermodynamic functions was the Rand method. (auth)

26412 SCATTERING OF ELECTROMAGNETIC WAVES BY FIELD-ALINED PLASMA COLUMNS. Sato, Tetsuya; Maeda, Ken-ichi (Kyoto Univ.). Radio Sci., 3: 351-68(Apr. 1968).

Radio wave scattering from field-aligned plasma columns is treated for application to the ionospheric irregularities with well-defined structure. A scattering model is introduced in which a sufficient number of homogeneous (cylindrical) plasma columns of the same kind and shape are embedded along the magnetic field in an isotropic scattering medium. Scattering patterns of a cylindrical column of finite length are calculated for oblique incidence. It is shown that the polarization of scattered waves deviates appreciably from the incident one for sufficiently large obliquity, say larger than 30°. (auth)

26413 ON THE REALIZATION OF RANDOM SURFACES. Rusbridge, M. G. (Culham Lab., Abingdon, Eng.). J. Comput. Phys., 2: 288-305(Feb. 1968).

For certain numerical experiments on the behavior of fluctuations in a plasma it is useful to be able to construct examples of random surfaces. These are functions of two variables which are members of ensembles which can be characterized only by statistical properties. Only homogeneous surfaces in which these statistical properties are independent of position are considered. The problem is this: given a correlation function and sets of random numbers, to operate on these sets so as to produce successively members of the ensemble of functions with the specified correlation function. Two possible methods of doing this are described and contrasted, one based on Fourier synthesis and the other on the theory of optimum linear prediction. (auth)

26414 THEORETICAL CALCULATION OF TRANSPORT PROPERTIES IN NITROGEN EQUILIBRIUM PLASMA. Penski, K. (Univ., Stuttgart). pp 189-202 of Proceedings of the Fourth Symposium on Thermophysical Properties. Moszynski, J. R. (ed.). New York, The American Society of Mechanical Engineers, 1968.

From 4th Symposium on Thermophysical Properties, College Park, Md. See CONF-680403.

The thermal conductivity λ and viscosity η of the thermal nitrogen plasma are computed by application of the rigorous kinetic theory of gases. The contribution of the ionization to λ is calculated directly from the internal electric field density without introducing the ambipolar diffusion coefficient. The influence of the lack of information regarding the cross sections on the resulting uncertainties is examined. By comparing the calculated and experimental values of λ, it is shown that the important diffusion collision integrals of the $N-N^+$ interaction differ only slightly from those of the $N-N$ interaction. It is shown that the equation of Buddenberg and Wilke is not valid for the calculation of the viscosity of the plasma. The calculated values of λ and η at various pressures are given and compared with other theoretical and experimental investigations. (auth)

26415 EXISTENCE CONDITIONS FOR FAST ELECTRON POPULATION IN A HF CAPACITIVE DISCHARGE. Vacquie, S.; Bacri, J. (Faculte des Sciences, Toulouse). Phys. Lett., 26A: 472-3(Apr. 8, 1968). (In French).

A simple theoretical model is proposed to explain the presence of fast electrons in a hf electrodeless capacitive discharge at low pressures ($p < 10^{-2}$ torr). (auth)

26416 EXCITATION OF PSEUDOSONOROUS IONIC WAVE IN CYLINDRICAL PLASMA BY AN ELECTRON BEAM. Mills, Pierre; Doucet, Henri (Faculte des Sciences, Paris. Ecole Polytechnique, Paris). Compt. Rend., Ser. A and B, 266: 149-52(Jan. 15, 1968). (In French).

The dispersion of an ionic wave in a plasma column having a transverse density gradient has been observed. On the injection of an electron beam, an instability appears which was interpreted as the amplification of this ionic wave by an inverse Landau effect. (tr-auth)

26417 CALCULATION OF THE ANISOTROPIES AND HARMONICS OF THE ELECTRON DISTRIBUTION FUNCTION OF AN IMPERFECT INHOMOGENEOUS LORENTZIAN PLASMA. Jancel, Raymond (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 153-60(Jan. 15, 1968). (In French).

A general method for the calculation of nonlinear effects arising in an inhomogeneous Lorentz plasma exposed to an oscillating electric field is reported. (J.S.R.)

26418 CHARGED PARTICLE ACCELERATION IN PLASMA. Fainberg, Ya. B. Usp. Fiz. Nauk, 93: 617-31(Dec. 1967). (In Russian).

The subject is reviewed, with particular attention being devoted to the work contributed by V. I. Veksler. Extensive references are included. (R.V.J.)

26419 STATISTICS OF ONE PLASMA MODEL. Sibgatullin, N. R. (Moscow State Univ.). Vestn. Mosk. Univ., Ser. I, Mat. Mekh., No. 4, 114-25(1967). (In Russian).

A complete set of kinetic equations is derived for a nonradiating plasma in electric and magnetic fields. The plasma is assumed to be spatially homogeneous, and relativistic effects are taken into consideration. The two-moment approximation is used to derive a closed system of equations. (TSS) (ATD)

26420 DISTRIBUTION OF PLASMA POTENTIAL FOR AN MPD THRUSTER. Hoell, J. M.; Brooks, D. R. (Langley Research Center, Hampton, Va.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 723-5(Apr. 1968).

Spatial surveys with Langmuir probes of the plasma potential distribution in a medium power (3 to 7 kW) MPD thruster are presented. (M.H.R.)

26421 SPIN-INDEPENDENT OSCILLATIONS OF A DEGENERATE ELECTRON LIQUID. Ying, S. C.; Quinn, J. J. (Brown Univ., Providence). Phys. Rev. Lett., 20: 1007-10(Apr. 29, 1968).

A dispersion relation valid for arbitrary wavelength of the spin-independent oscillations of an electron fluid is derived. Analytic expressions for the long-wavelength limit can be obtained quite easily. In addition, results for all wavelengths can be obtained numerically for the situation in which the Fermi-liquid interaction is approximated by a finite series of spherical harmonics. (auth)

26422 MOLIÈRE'S THEORY OF MULTIPLE SCATTERING. Case, C. T.; Battle, E. L. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Phys. Rev., 169: 201-4(May 5, 1968).

Arguments are given for the application of a theory developed by Molière (to describe multiple nuclear scattering) to the problem of electron scattering in a plasma. The basic equations are the same as those obtained and solved by Molière and at a later date by Bethe, but are derived herein in a hopefully simpler manner. Several applications for these results are suggested and a simple diffusion problem is solved as an example. It is concluded that there is a class of plasma collision problems

wherein an application of Molière's theory can yield interesting and useful results. (auth)

26423 ASYMPTOTIC ELECTRIC MICROFIELD DISTRIBUTIONS IN LOW-FREQUENCY COMPONENT PLASMAS. Hooper, C. F. Jr. (Univ. of Florida, Gainesville). Phys. Rev., 169: 193-5(May 5, 1968).

A recently developed collective-coordinate technique is employed to calculate electric microfield distribution functions $P(\epsilon)$ for low-frequency-component plasmas. Values of ϵ considered range from 10 to 50, and both neutral-point and charged-point cases are treated. Comparison is made with appropriate asymptotic expressions. (auth)

26424 EXPERIMENTAL MEASUREMENTS OF GAS PUMPING IN AN ARGON DISCHARGE. Chester, Arthur N. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 169: 184-93(May 5, 1968).

Measurements have been made of the pressure difference between the cathode and anode bottles of a standard cw argon ion laser tube, with a positive column of 30-cm length and 1.25-mm radius. At several amperes current the pressure difference (anode minus cathode) is approximately constant at 0.25 torr below 1.2 torr, and is inversely proportional to pressure above that pressure. The results are compared with the predictions of various theories. The theory presented in the preceding paper accurately predicts both the magnitude of the pumping effect and its dependence upon pressure and current. (auth)

26425 GAS PUMPING IN DISCHARGE TUBES. Chester, Arthur N. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 169: 172-84(May 5, 1968).

Collisions between gas atoms and charged particles in the positive column of a dc-excited gas discharge tend to cause an axial transport of gas between the ends of a discharge tube. Since, because of approximate charge neutrality, essentially equal forces are exerted on the plasma ions and electrons by the axial field, any net force on the gas must be balanced by an axial force exerted on the wall by the plasma. Earlier workers have treated this pumping by assuming that ions near the wall give their cathode-directed momentum to the wall rather than to neutral atoms, thus producing a net anode-directed force on neutral atoms close to the tube wall, this being the predominant force. Such a treatment is shown here to be an incomplete discussion of the forces acting on the neutral gas; moreover, the "wall pumping" force itself is shown to be incorrectly considered in the earlier work. At higher pressures, the principal gas pumping force turns out to be one that acts throughout the discharge volume, caused by the unequal radial distances traveled by ions and electrons between collisions with gas atoms. The pressure and radius dependences of gas pumping predicted by the present treatment differ substantially from those of earlier work. (auth)

26426 RECOMBINATION OF ELECTRONS AND MOLECULAR HELIUM IONS. Born, Gunthard K. (Army Electronics Command, Fort Monmouth, N. J.). Phys. Rev., 169: 155-64(May 5, 1968).

The recombination coefficient $\alpha(N_e, T_e)$ of He_2^+ is measured in helium afterglow plasmas ($12 \leq p \leq 20$ torr; $t \gtrsim 1$ msec) as a function of electron density and gas temperature under conditions where the temperature of electrons and ions equals that of the neutral gas (2.5×10^{12} cm$^{-3} \leq N_e \leq 2 \times 10^{13}$ cm^{-3}; 900°K $\leq T \leq$ 2200°K). The recombination coefficient is found equal to the theoretical collisional-radiative recombination rate of He^+. In spite of the high vibrational excitation of the recombining He_2^+, corresponding to the high gas temperatures there is no evidence for dissociative processes. In particular, the time decay of the recombination light cannot be reconciled with collisional-dissociative recombination. (auth)

26427 USE OF THE CHAPMAN–ENSKOG METHOD IN THE CASE OF TWO-TEMPERATURE BINARY GAS MIXTURES. Galkin, V. S. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 6, 58-63(Nov.-Dec. 1967). (In Russian).

Boltzmann's equations were used for obtaining the transport equations for two-temperature binary gas mixtures, as approximation similar to the Navier–Stokes approximation. Transport coefficients and relaxation terms for temperature equations were found. A method similar to the one described was also used by R. M. Chmieleski et al. (Phys. Fluids, 10: 364-371(1967)) for the case of partially ionized plasma. (R.V.J.)

26428 AIR FLOW BEHIND A STRONG SHOCK WAVE TAKING NONEQUILIBRIUM IONIZATION AND RADIATION INTO CONSIDERATION. Biberman, L. M.; Vorob'ev, V. S.; Lagar'kov, A. N.; Stulov, V. P.; Telenin, G. F.; Shapiro, E. G.; Yakubov, I. T. (Inst. of High Temperatures, Moscow). Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 6, 46-57(Nov.-Dec. 1967). (In Russian).

The state of a gas behind a shock wave front at a velocity of 10 km/sec is investigated with nonequilibrium ionization and radiation transfer taken into account. The real air spectrum, i.e., multiple lines, bands, and continua, are considered and also the electron and ion NO^+ recombination radiation. The consideration of the radiation leads to a system of integrodifferential equations, which is solved by an iteration method. The nature of ionization is established from an analysis of the velocities of reactions. The nonequilibrium ionization behind the shock front is considered for the case where the length of relaxation L is of the order of the layer thickness l, with electric conductivity taken into account. Profiles of gas parameters behind the shock front dependent upon relaxation processes and radiation cooling are obtained for v = 10–16 km/sec, at pressures ahead of the wave front $p = 10^{-5}$ to 10^{-2} atm. Only the layer of a gas bounded by the shock front and a plane parallel to it is considered in order to obtain sufficiently valid results, and assuming that the gas inside these boundaries is not irradiated from the outside. The analysis of the results shows that under the conditions considered here, where $l \gg L$, a strong influence of radiation on the gas state is observed, gas cooling leads to a drop by two times in the radiation flux q, and radiation cooling leads to the disruption of ionization equilibrium. Owing to energy losses the temperature falls and the degree of ionization is not able to "follow" it; therefore, the local concentration of charged particles exceeds that of equilibrium. It is stated that this type of nonequilibrium, which is typical for decaying plasma, is noted for the first time for a plasma behind a shock wave. (ATD)

26429 PLASMA IN INTERPLANETARY SPACE. Biermann, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Scientia (Milan), 102: 187-96(May-June 1967). (In German).

The closest example of a plasma of nearly cosmic dimensions and correspondingly low density is the interplanetary plasma, whose existence in interplanetary space was inferred indirectly in the last 15 years, and then demonstrated directly when space probes became available. Theoretical processes from the physics of magnetic storms, comets, and cosmic electrodynamics, which are significant in the present considerations of interplanetary plasma, are discussed from a point of view of historical development. Similar properties of interplanetary and interstellar space, taking relative densities into account, are indicated; and similar magnetic field intensities are anticipated as well. Consequently, present work in interplanetary plasmas should be of value in the study of interstellar plasmas as well. (BBB)

26430 RADIATION EMITTED BY THE IONIZED RARE GASES IN REFLECTED SHOCK WAVES. Mies, Frederick Henry. Providence, Brown Univ., 1961. 193p.

Thesis.

The radiations emitted by the ionized rare gases, Ar, Kr and Xe are described. The ionized gases were formed in the reflected shock waves created in a shock tube in which the equilibrium temperatures ranged from 7,500 to 12,000°K, and the electron densities from 10^{15} to 10^{18} cm^{-3}. The ultraviolet and visible radiation emitted from the system was composed of the line spectra of the atoms (and ions) superimposed on an intense background of continuum emission. (TSS) (Disser. Abstr.)

26431 ELEKTRONISCHE VORGAENGE IN GASEN UND FESTKOERPERN. (Electronic Processes in Gases and Solids). Schulz, Paul. Karlsruhe, Ger., Verlag G. Braun, 1968. 549p.

For the treatment of many new electrical engineering problems, quantum theory is fundamental. An introduction is therefore given to quantum physics as this is necessary for the processing of phenomena in gas plasmas and solids. Processes in gas plasmas are essential in electric discharge tubes, in many switching processes, breakdown phenomena, and corona discharge of high-voltage systems. Studies on the direct conversion of heat into electrical energy and production of energy from stabilized high-temperature plasmas are of increasing interest. Electronic phenomena in solids—behavior of electric conductors, insulators, and semiconductors—are basic for many modern technical problems. Processes in gas plasma are considered with respect to ions and electrons in the electrical field, production of charge carriers in gases and on surfaces, transition from the dependent to the independent discharge, the independent discharge, processes at the electrodes, and plasma in the magnetic field. The processes in solids are considered with respect to electrical conductors and insulators, crystals with faults, luminescence, and dielectric and magnetic properties of matter. (J.S.R.)

26432 FIZIKA PLAZMY: KOLLEKTIVNYE PROTSESSY V PLAZME I TURBULENTNYI NAGREV. (Plasma Physics: Col-

lective Processes in Plasma and Turbulent Heating). Zavoiskii, E. K.; Rudakov, L. I. Moscow, Izdatel'stvo Znanie, 1967. 32p.

The first chapter includes data on the quasilinear oscillation theory, plasma instabilities, electron and ion beam delay in plasma, and turbulent heating of plasma by currents. Experimental data on turbulent heating of plasma in magnetic traps and current instabilities in strong electrical fields are discussed in the second chapter. (R.V.J.)

Production of Plasma

26433 ON THE ANALYSIS OF IONIZATION GROWTH TIMES IN NEON. Davies, R. D.; Evans, C. J. (University Coll. of Swansea, Wales). J. Phys., D, 1: 319-25(Mar. 1968).

In calculating the secondary photoelectron yield in a gas discharge it is not always possible to consider relatively long-lived resonance or metastable states separately because of transitions between them (natural or collision-induced). A theory is first developed for any collection of excited states, giving formulae for the secondary electron yield and for the temporal growth of ionization. It is shown how the formulae were used to analyze experimental data for neon, and to calculate the relative contributions of the various secondary ionization processes. (auth) (UK)

26434 NUMERICAL SOLUTION OF THE FOKKER–PLANCK EQUATIONS FOR A HYDROGEN PLASMA FORMED BY NEUTRAL INJECTION. Killeen, John; Futch, Archer H. (Univ. of California, Livermore). J. Comput. Phys., 2: 236-54(Feb. 1968).

A program is described for the solution of the time-dependent Fokker–Planck equations for electron and ion distribution functions in velocity space. The formation of a plasma in a magnetic mirror configuration by the injection of energetic neutral atoms is considered. In the equations one has a source of energetic protons and cold electrons, and losses due to scattering and charge exchange are included. The coupled nonlinear partial differential equations are solved by an implicit difference method which is described. Numerical results are presented for two cases of interest. (auth)

26435 FORMATIVE TIME FOR BREAKDOWN IN STRONG CROSSED FIELDS. Sherwood, Arthur R.; Kunkel, Wulf B. (Univ. of California, Berkeley). J. Appl. Phys., 39: 2343-8 (Apr. 1968). (UCRL-17955).

The formative time of electric breakdown in low-pressure (0.2 to 2.0 torr) hydrogen across a strong magnetic field ($10 < \omega_b\tau < 350$; maximum B of 18 kG) has been measured in a coaxial cylindrical geometry. Attention was centered on the region of breakdown that occurs with a formative time less than the time required for an electron to drift across the electrode gap in the applied fields. This crossing time was inferred by extrapolations of previous measurements by Bernstein. These formative time measurements are compared with a simplified theory that assumes a constant number of e-folding times until breakdown and neglects electron losses as well as secondary production at the cathode. This model predicts that the formative time is inversely proportional to the gas pressure and otherwise a function of only the ratio E/B and not of either field separately. The predicted pressure dependence is confirmed, but some deviations from the predicted functional dependence on E/B are found. These deviations are attributed to electron losses along the magnetic field. A prediction of the magnitude of the formative time based on this simplified theory must necessarily involve extrapolation of certain previously obtained results. Such a prediction is found to be in reasonable agreement with the experimental values. (auth)

26436 LASER PRODUCED PLASMA FROM SOLID HYDROGEN FOILS. Sigel, R.; Buechl, K.; Mulser, P.; Witkowski, S. (Institut fuer Plasmaphysik, Munich). Phys. Lett., 26A: 498-9(Apr. 8, 1968).

A giant pulse ruby laser was focused onto solid hydrogen foils. The laser light was found to be absorber in a layer which penetrates the solid with a velocity of 3×10^8 cm/sec. (auth)

Stability of Plasma

Refer also to abstract 26359.

26437 RADIAL PROFILE OF THE PERTURBATION DENSITY FOR THE HELICAL INSTABILITY IN A POSITIVE COLUMN. Reynolds, J. F.; Jennings, W. C.; Gunshor, R. L. (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Fluids, 11: 1048-9(May 1968).

An experimental investigation is made of the perturbation density at the onset of the helical instability in a positive column. Close agreement is found with the theoretical form assumed by Kadomtsev and Nedospasov. (auth)

26438 ON THE THEORY OF UNSTABLE PLASMAS IN THE RING APPROXIMATION (2d COMMUNICATION). Grecos, A. P. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg., 53: 1007-18(1967).

The asymptotic forms of the kinetic equation for a strongly stable, weakly stable, and a weakly unstable plasma are outlined. Also, the corresponding expressions for the density correlation function are given. The connection with the wave–particle interaction theory is also discussed. (M.O.W.)

26439 THEORY OF LONGITUDINAL PLASMA INSTABILITIES. Hasegawa, Akira (Osaka Univ.). Phys. Rev., 169: 204-14(May 5, 1968).

A stability theory of longitudinal disturbances in a plasma is presented. The theory states necessary conditions and a necessary and sufficient condition of the instability in terms of the mathematical nature of linear plasma conductivities on the real ω axis, by introducing an idea of passive and active conductivities combined with Nyquist diagram techniques. It is applied to obtain conditions of instability in both collision-dominated and collision-free plasmas in the presence of a uniform magnetic field. Effects of drift, density gradient, and temperature anisotropy appear as the causes of the active conductivities, whose presence is shown to be the basic necessary condition for an instability. Each of these effects contributes differently to the conductivity, giving a different necessary and sufficient condition for the associated instability. (auth)

Shielding

Refer also to abstracts 26759, 26761, and 27450.

26440 (GEMP-599) SHIELD KERNEL-DIFFUSION ANALYSIS. Edwards, W. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Mar. 1968. Contract AT(40-1)-2847. 100p. Dep. CFSTI.

A kernel-diffusion analysis sequence, and associated nuclear data, were developed for shield nuclear analysis. The methods, analysis sequence, and programs are described briefly in this report; and the nuclear data are tabulated. (auth)

26441 (LA-DC-9215) STORAGE AND RETRIEVAL OF PHOTON PRODUCTION AND INTERACTION DATA IN THE ENDF/B SYSTEM. Dudziak, Donald J.; LaBauve, R. J. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 8p. (CONF-680307-27). Dep. CFSTI.

From 2nd Conference on Neutron Cross Sections and Technology, Washington, D. C.

In order to allow for the storage and convenient subsequent retrieval of data needed in shielding calculations, the ENDF/B format has been extended to include photon production and photon interaction data. Data allowed in the files include: interaction cross sections; atomic form factors for incoherent and coherent scattering; photon (or other secondary radiation) angle, energy, and energy-angle distributions; discrete levels of the nucleus with associated transition probabilities; and photon production multiplicities. The format is kept as consistent as possible with the existing ENDF/B format and requires no changes in it. A detailed proposal for the format has been approved by the Cross Section Evaluation Working Group (CSEWG). A processing code to put photon production data into forms usable in photon transport codes is being written at the Los Alamos Scientific Laboratory. Data for photon production in sodium have been entered on a test ENDF/B tape for debugging the processing codes, and similar data for magnesium, chlorine, potassium, and calcium are being prepared. Evaluations of these elements by M. K. Drake et al. are being translated from UK to ENDF/B format by a code written at LASL. (auth)

26442 PLASMA RADIATION SHIELD: CONCEPT AND APPLICATIONS TO SPACE VEHICLES. Levy, Richard H.; French, Francis W. (Avco-Everett Research Lab., Everett, Mass.). Contract NAS8-20310. J. Spacecraft Rockets, 5: 570-7(May 1968).

The plasma radiation shield is an active device using free electrons and electric and magnetic fields for the purpose of shielding astronauts from energetic solar-flare-produced protons. The concept of plasma radiation shielding is reviewed in the light of current studies. The available evidence indicates that the concept is physically sound, but important practical questions remain in at least two areas; these have to do with establishment and control of the extremely high voltages required, and with integration of the concept into a realistic space vehicle design. Other aspects of the plasma radiation shield discussed include selection of the shield-

ing voltage, vehicle configuration possibilities, some aspects of the superconducting coil system, and the vehicle power supply. The effects of the plasma radiation shield on the communications, attitude control, propulsion, and life-support systems of the space vehicle are also considered. (auth)

26443 ATTENUATION OF X RAYS AND GAMMA RAYS IN CONCRETE. Foster, Bruce E. (National Bureau of Standards, Washington, D. C.). Mater. Res. Stand., 8: 19-24(Mar. 1968).

Physical aspects of x-ray shielding as applied to concrete are dealt with. A brief description is given of the characteristics of x and γ rays, followed by a discussion of attenuation by the photoelectric, pair-production, and Compton effect mechanisms, as a function of x-ray or γ-ray energy, and barrier material. Performances of various shielding materials in various energy ranges are compared, and the problems in shield design brought about by the scattering processes are discussed. The mass attenuation coefficient is shown for the photoelectric effect, electron-pair production, Compton effect, and the sum of these, as a function of x-ray energy, for lead and for a conventional structural silica-aggregate concrete with assumed proportions of 50% oxygen, 40% silicon, and 10% calcium. These data show the relative effectiveness for equal weights of shield material, not for shields of equal thickness. For example, for 2-MeV x rays a required 50-in. thick conventional concrete shield would be equivalent to 10 in. of lead. The magnitude of the Compton effect for lead is lower than for concrete (because it has fewer electrons per lb) and in the important range of 2 to 3 MeV where the Compton effect contributes most of the attenuation, the total attenuation for lead and for concrete is about equal. The data also show why lead is the preferred shielding material for x rays of less than about 0.5-MeV energy. (BBB)

26444 SABINE: PROGRAM FOR SHIELDING CALCULATIONS IN PLANE, CYLINDRICAL, AND SPHERICAL GEOMETRIES. Ponti, C. (EURATOM-CCR, Ispra, Italy). pp 1-10 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967.

From Conference on Radiation Protection, Hanover. See CONF-661060.

26445 THE TREATMENT OF GAMMA RADIATION IN THE SHIELDING CALCULATION PROGRAM SABINE. Preusch, H. (AIV Buero, Darmstadt, Ger.). pp 11-17 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

The SABINE computer program was developed to describe the important data as well as possible within the framework of a point-core diffusion method. The physical model on which the program is based, the source distribution, and the theoretical principles are outlined. (J.S.R.)

26446 DEGREE OF ATTENUATION IN BROAD RADIATION BEAMS IN LEAD, STEEL, CONCRETE, AND WATER. Honig, A. (Technische Hochschule, Brno). pp 19-20 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

In the design of shielding it is usual in the determination of the necessary shield thicknesses to calculate first the exponential attenuation of the primary radiation and to consider the scattered radiation by a growth factor. It is proposed that, in place of the growth factor, a degree of attenuation defined as K = photoeffect of the attenuated beam/photoeffect of the non-attenuated beam be used. For lead, steel, concrete, and water, the degree of attenuation was calculated for energies between 0.5 and 10 MeV and for various shielding thicknesses using the Taylor formula with the LGP 30. (tr-auth)

26447 THE FURTHER DEVELOPMENT OF THE GAMMA TRANSPORT PROGRAM BIGGI 4. Penkuhn, H. (EURATOM-CCR, Ispra, Italy). pp 21-7 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

As the basic assumptions and equations of the BIGGI 4 program have already been published, some concrete problems that can be solved with the various programs and the developments recently introduced are outlined. (J.S.R.)

26448 EXPERIENCE WITH THE MONTE CARLO PROGRAM GAMMONE FOR THE CALCULATION OF GAMMA RADIATION SHIELDING. Wueneke, C.-D. (Technische Hochschule, Hanover). pp 29-39 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

The GAMMONE program is a computer program for the calculation of the shielding of γ radiation by layered shields. It uses the Monte Carlo technique to simulate the interaction processes of the γ radiation in the shield. The stochastic methods that GAMMONE uses are briefly explained. The growth factors and albedo values obtained with the GAMMONE program are shown graphically. (J.S.R.)

26449 DEVELOPMENT AND APPLICATION OF TWO COMPUTER PROGRAMS FOR THE EVALUATION OF THE RESULTS OF GROWTH FACTOR MEASUREMENTS IN NARROW-BEAM GEOMETRY. Vogt, H. G. (Technische Hochschule, Hanover). pp 41-56 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

Two computer programs were developed for the automatic processing of measurement data on growth functions for any shield configuration, in which the radiation field originates from an isotropic point source or an infinitely expanding surface source. The function of these programs and some of the results obtained with them, from measurements on special material layers of iron and water are reported. The calculation of the dose values from the pulse-height spectra and of the dose growth factors for monoenergetic gamma radiation is described. (J.S.R.)

26450 COMPARISON OF THE ESTAKOS MEASUREMENT VALUE WITH SOME RESULTS OBTAINED IN OTHER SOURCE GEOMETRIES. Thuro, G.; Schnier, C. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). pp 83-95 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

The construction of the ESTAKOS, a device for radiation shielding with collimated beam, is briefly described. The geometric functions of other source geometries are given. The results obtained on water by the ESTAKOS are compared with those obtained by the ESTAGROP, the Bulk Shielding Reactor, and the Lid Tank Shielding Facility. The agreement in all cases is good. (J.S.R.)

Solid-State Physics

Refer also to abstracts 25355, 25357, 25661, 25693, 26231, 26265, 26266, 26764, and 26782.

26451 (AERE-R-5743) PROTON SCATTERING AS A TOOL FOR THE STUDY OF CRYSTAL STRUCTURES. Nelson, R. S. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 24p. Dep. CFSTI. UK.

The regular nature of the crystal lattice has a marked influence on the trajectories of protons traveling through crystalline solids, and on the spatial distribution of protons elastically scattered from their surfaces. The periodic potentials existing within the crystal cause the protons to undergo correlated collisions with the lattice atoms so that their trajectories are steered either along or away from certain well defined crystallographic directions. Such steering effects have been termed "Channelling" and "Blocking," respectively. A description is given of a new technique based on these phenomena which can be usefully employed to study both the structure of crystals and the atomic positions of impurity atoms within the crystals. (auth)

26452 (GEMP-594) VACANCY DISLOCATION LOOPS IN IRRADIATED AND ANNEALED TUNGSTEN. Rau, Robert C. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). [1968]. Contract AT(40-1)-2847. 16p. Dep. CFSTI.

Electron-diffraction contrast experiments were performed to crystallographically characterize the dislocation loops which form during 1100°C annealing of neutron-irradiated tungsten. These experiments show that the loops are essentially pure edge in orientation, lying on or near {111} habit planes and having a/2 ⟨111⟩ Burgers vectors. The loops surround platelets of condensed

vacancies which are believed to represent the excess vacancy population remaining after annealing of interstitials. (auth)

26453 (UCRL-70670(Rev.1)) NUMERICAL PROBLEMS WITH GRUENEISEN RATIOS. Richter, H. P. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 22, 1968. Contract W-7405-eng-48. 27p. (CONF-680102-4). Dep. CFSTI.
From Meeting of the American Physical Society, Chicago, Ill.

Two numerical problems are encountered in equation-of-state calculations performed on shock phenomena: (1) The obtained values for the Grüneisen ratio deviate considerably from the actually given thermodynamic values at the initial point. (2) When problem 1 is eliminated, the Grüneisen ratios and their derivatives tend to values being inconsistent with derived thermodynamic relations at the high-pressure range. It is shown that a Grüneisen ratio derived by equating derivatives of the Mie-Grüneisen equation of state and the Hugoniot function eliminates both problems. Evidence to this effect is supplied by using a second thermodynamic relationship derived in a similar manner. Potassium chloride and aluminum were chosen as material samples. (auth)

26454 (UCRL-Trans-10225) DETECTION OF SMALL AMOUNTS OF SUBSTANCES BY MEANS OF EXO-ELECTRONS. Kramer, J. Translated for Univ. of California, Lawrence Radiation Lab., Livermore, from Z. Angew. Phys., 22: 272-8 (1967). 29p. Dep. CFSTI. JCL $2.60 fs, $1.07 mf.
Abstract of Original in NSA, 21: 16988.

26455 TRAPPING AND THERMAL RE-EMISSION OF HELIUM FROM POLYCRYSTALLINE TUNGSTEN. Erents, K.; Carter, G. (Univ. of Liverpool). Vacuum, 16: 523-8(1966).

Observations of trapping and subsequent thermal re-emission of 100-eV to 2-keV He^+ ions at a polycrystalline tungsten target are reported. The trapping probability of He^+ ions increased monotonically in this energy range and was slightly higher than for Ar^+ ions. Thermal re-emission after trapping revealed peaks in the re-emission spectrum with corresponding activation energies for the major components of 1.6 eV, 2.0 to 3.0 eV, and 5 to 6 eV. These energies are believed to be correlated with motion of tungsten surface atoms and with vacancies. The increased trapping probability for He ions is ascribed to the weaker interaction potential for the ions than for Ar, allowing easier penetration. Further investigations with single crystals could provide important data both on the interaction potential and on the migration energies of tungsten. The ion bombardment technique appears to be useful for introducing a diffusant ion or atom to a target without necessarily producing damage. This must be achieved with low-energy ions where energy transfer is minimum. Increasing the ion energy could give information on radiation damage processes. (BBB)

26456 CONTRASTS OF DIFFRACTION IN DIFFUSE RADIATION NEAR A BRAGG SPOT. El Hili, Ali (Faculte des Sciences, Orsay, France). J. Microscop., 6: 725-58(Nov. 1967). (In French).

From observation of monocrystal images viewed in quasi-elastic or inelastic scattered radiation using a transmission-type electron microscope, it is found that inelastic scattering by plasmons has essentially the same effect on each of the two waves of the dynamic theory of two beams. The selective weakening of one of the two waves, which causes the disappearance of the fringes beyond a given thickness, results in large measure from quasi-elastic scattering by phonons. Persistence of an easily observed contrast on the images produced by quasi-elastically scattered electrons in the vicinity of a Bragg spot would imply the existence of a certain degree of coherence between waves scattered by phonons. All experimental studies were done with images filtered without loss or with characteristic loss; eventually quantitative studies can be undertaken such as the measure of absorption coefficients μ_0 and $\Delta\mu_g$, and the determination of relative positions of fringes of equal thickness observed in filtered images without loss and with characteristic loss. (BBB)

26457 JUNCTION REACTION HARDENING BY DISLOCATION LOOPS. Foreman, A. J. E. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 17: 353-64(Feb. 1968).

The movement of a flexible dislocation line through a random array of circular dislocation loops was studied, using a digital computer, on the basis of the line tension approximation. The dislocation moves on a {111} plane of a face-centered cubic crystal and interacts with {110} prismatic loops by the formation of short junction reactions at the points of intersection. The critical stress required to propagate the dislocation through the loops is $\mu b/1.75L$, where L is the average spacing of the reactive loops cutting the glide plane (one-third of all the loops are reactive). This result is independent of the radius and sense of the loops and the edge-screw character of the glide dislocation. It is slightly increased when the loops are distributed more uniformly, in disagreement with the factor two reduction predicted by Westmacott et al. (1966). The present estimate of loop hardening is comparable with the tetragonal distortion model of Fleischer (1962), and is in agreement with the measured hardening of quenched aluminum. It is almost identical with the value for a random array of simple obstacles with a flat spectrum of strengths. The result is an order of magnitude larger than the previous estimate by Friedel (1963), which was based on the zig-zag model. This model is applicable only at zero stress, since it neglects the additional pinning points that are encountered by a dislocation when it bows under stress. The critical stress may be increased if the mobility of the loops allows the formation of longer junctions. (auth) (UK)

26458 MAGNETIC CERAMICS: A REVIEW AND STATUS REPORT. Brockman, Frank G. (Philips Labs., Braircliff Manor, N. Y.). Amer. Ceram. Soc. Bull., 47: 186-94(Feb. 1968).

Properties and applications of the technically important ceramic-like magnetic materials (ferrites, magnetoplumbites, and garnets) are reviewed with special regard for their structures as related to ferrimagnetism, their electrical and magnetic properties, and their interrelations. There are two reasons why magnetic ceramics are technically important: the electrical resistivity of the ceramic materials is at least 10^6 times as great as the electrical resistivity of the metallic materials, and ceramic materials may be cheaper than the metallic materials. One application is in high-energy proton accelerators. The 30-BeV AGS accelerator at the Brookhaven National Laboratory has 12 accelerating stations, each about 7 ft long, filled with ferrite rings 35-cm OD, 20-cm ID, and 2.1-cm thick. In all, this accelerator contains about 7 tons of ferrite. A photograph of the internal ferrite structure for one of these 12 stations is illustrated. Other installations involving massive cores of ferrites are the cosmotron at Brookhaven, the ZGS proton accelerator at Argonne, and the Princeton-Pennsylvania accelerator at Princeton. The Princeton-Pennsylvania accelerator contains the largest single pieces of ferrite ever made. These rings are 50 cm OD, 30 cm ID, and 2.5 cm thick. A Princeton ring, a Brookhaven ring, and a smaller ring made for a European accelerator are illustrated. (BBB)

26459 CRYSTAL FIELD SPLITTINGS IN Fe^{3+} TUTTON SALTS FROM MOESSBAUER STUDIES. Raj, Deo; Chandra, K.; Puri, S. P. (Univ. of Roorkee, India). pp 83-90 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27-March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220-(Vol.1).

The Moessbauer spectra of iron Tutton Salts $(M_2Fe(SO_4)_2 \cdot 6H_2O$, where M = NH_4, K, Rb, Cs, and Tl) were studied over a temperature range from 77 to 300°K. The data are analyzed to assign characteristic temperatures of the t_{2g} levels and find their splittings. The effect of electronegativity of M is also discussed. (auth)

26460 ^{57}Fe MOESSBAUER EFFECT IN $SrTiO_3$. Bhide, V. G.; Bhasin, H. C. (National Physical Lab., New Delhi). pp 76-82 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27-March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220-(Vol.1).

A study was made of the Moessbauer effect for ^{57}Fe in $SrTiO_3$ used both as a source as well as an absorber. $^{57}Co:SrTiO_3$ when matched against an enriched 310 stainless steel absorber gives a complex spectra which can be assigned to the existence of low-spin ferric Fe(III) state ($d\varepsilon^5$) and high spin ferric Fe^{3+} state ($d\varepsilon^3 dr^2$). Heat treatment of the sample alters the relative intensity of the two states. The stability of these two states produced from the electron capture by diamagnetic Co(III) ($d\varepsilon^6$) in this lattice is discussed. The electronic structure of the transition metal impurity in the lattice is shown to be determined not only by the Dq/B but also by the chemical potential of the lattice as determined by the nonstoichiometry. Air-fired ^{57}Fe-doped $SrTiO_3$ absorbers when matched against a $^{57}Co:Cu$ source gives a quadrupole split spectra arising out of Fe^{3+} associated with a near neighbor oxygen vacancy. On firing this sample in hydrogen for 4 hours at 1100°C, a Zeeman split spectra is obtained indicating the formation of iron clusters. On refiring the sample in air, the quadrupole split spectra is again reproduced. The changes caused on hydrogen and air firing are perfectly reversible. The possibility of superparamagnetism is discussed. (auth)

26461 MOESSBAUER RELAXATION SPECTRA OF ^{119}Sn IN THE INTERMETALLIC COMPOUNDS $EuSn_3$ AND $GdSn_3$. Kanekar, C. R.; Mallikarjuna Rao, K. R. P.; Rao, V. Udaya Shankar (Tata Inst. of Fundamental Research, Bombay). pp 65-75 of Proceedings of the Nuclear Physics and Solid State Physics Sympo-

sium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.1).

Moessbauer nuclear hyperfine relaxation spectra of ^{119}Sn have been observed in the paramagnetic state at 90°K in the intermetallic compounds, $EuSn_3$ and $GdSn_3$. The room-temperature spectrum in each of the compounds consists of a quadrupole doublet whereas at 90°K the spectrum shows well-resolved structure due to the magnetic hyperfine interactions. The spectra at 90°K are explained as due to the slowly relaxing S-state rare-earth ions Eu^{2+} and Gd^{3+}. The hyperfine fields at ^{119}Sn arise due to the conduction electron polarization by these rare-earth ions. The cubic crystal field at the rare-earth site splits the $^8S_{7/2}$ level of the free ion into two doublets Γ_8 and Γ_7 and a quartet Γ_8, all of which are populated because of the small total splitting of the order of 0.1 cm^{-1}. It is shown that only rare earth ions in Γ_7 level can give rise to a relaxation spectrum. The observed spectrum is explained on the above basis and the internal field at ^{119}Sn when a near neighbor rare earth is in the Γ_7 level is evaluated. The magnitude of the exchange interaction between the rare earth spin and the conduction electron spin is obtained from the hyperfine field on the basis of the RKKY theory and is found to agree with the EPR measurements of g shifts of the rare earth ions in these compounds. The exchange coupling is compared with the values obtained for other RSn_3 compounds from Knight shift studies. (auth)

26462 MOESSBAUER STUDIES OF CHALCOPYRITE. Raj, Deo; Chandra, K.; Puri, S. P. (Univ. of Roorkee, India). pp 91-4 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.1).

Moessbauer spectra of naturally occurring mineral chalcopyrite have been studied over a temperature range from 300 to 448°K, with a view to deciding the charge state of the Fe atom. Iron is principally covalently bonded with sulfur atoms. It is concluded that the iron atom is surrounded by a regular tetrahedron of sulfur atoms and is in the Fe(III) state in agreement with the neutron-diffraction data. The values of internal magnetic fields are 325 ± 10, 312 ± 10, and 290 ± 10 kG at 300, 373, and 448°K, respectively. (auth)

26463 PARAMAGNETIC SCATTERING OF NEUTRONS IN CHROMIUM TRIBROMIDE. Rao, L. Madhav; Murthy, N. S. Satya; Venkataraman, G. (Bhabha Atomic Research Centre, Trombay, India). pp 158-62 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Kanpur, February 27–March 3, 1967. Solid State Physics. Trombay, India, Bhabha Atomic Research Centre, 1967.
See CONF-670220–(Vol.1).

Energy distribution of neutrons scattered from chromium tribromide in its paramagnetic phase has been measured using the time-of-flight technique. Chromium tribromide is an ionic ferromagnet with a Curie temperature of 37°K. At large momentum transfers, the second moment of the energy distribution is directly related to the exchange integral J, according to De Gennes. De Gennes' prescription is strictly valid for a system of localized magnetic moments which arise purely out of the spins of the unpaired electrons. Further, the method is eminently suitable for those substances where there is only one dominant exchange integral. Chromium tribromide satisfies all these conditions. Measurements have been made at two momentum transfer values and the exchange integrals are extracted from these measurements. (auth)

26464 CHANNELOGRAPHY: METHOD FOR STUDY OF CRYSTAL DEFECTS. Quere, Y. (CEN, Fontenay-aux-Roses, France). J. Phys. (Paris), 29: 215-19(Feb.-Mar. 1968). (In French).

Alpha particles emitted from an isotopic source and traversing a metallic foil of adequate thickness, produce on a collector an image of the foil. The image is shown to be due to channeled particles. The influence, on the contrast, of orientation, of grain (or twin) boundaries, stacking faults and dislocations is studied. Patterns are observed which are related to channeling in low index planes. (auth)

26465 NEUTRON-DIFFRACTION STUDY OF THE NUCLEAR AND MAGNETIC STRUCTURE OF $DyAlO_3$. Bidaux, R.; Meriel, P. (CEN, Saclay, France). J. Phys. (Paris), 29: 220-4(Feb.-Mar. 1968). (In French).

$DyAlO_3$ is antiferromagnetic below $T_N = 3.48 \pm 0.03$°K. The magnetic space group is $Pb'n'm'$, the magnetic structure of G_xA_y type. The angle of the magnetic moment of Dy ions (8.8 ± 0.3 μ_B at absolute zero) with the a axis, 57° ± 2°, is independent of temperature. Interactions are, for the most part, dipolar. (auth)

26466 STUDY OF COBALT BOMBARDED BY ELECTRONS AT 20°K. Sulpice, G.; Minier, C.; Moser, P.; Bilger, H. (CEN, Grenoble, France). J. Phys. (Paris), 29: 253-6(Feb.-Mar. 1968). (In French).

Electrical resistivity measurements seem to indicate that the point defects produced in high-purity cobalt by electron irradiation at 20°K are essentially close pairs, which annihilate below 65°K. (auth)

26467 ON THE THEORY OF SLOW NEUTRON SCATTERING IN MAGNETO-ORDERED CRYSTALS. Akhiezer, I. A.; Bolotin, Yu. L. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 13: 492-9(Mar. 1968). (In Russian).

Slow neutron scattering in magneto-ordered crystals was studied with due regard for magneto–elastic coupling. Antiferromagnetics with an easy axis or easy plane and ferromagnetics with an easy plane are considered. It is shown that in the vicinity of magneto–acoustic resonance two additional maxima appear in the neutron scattering differential cross section, while the total cross section remains unchanged. Magneto–elastic coupling also plays an essential role in the slow neutron scattering by sound waves in ferromagnetics with a large value of the magneto–elastic constant. In this case the scattering cross section may be several times as large as in the case of a nonferromagnetic crystal. (auth)

26468 EXCITATION OF ALFVEN AND SPIRAL WAVES IN A SOLID BY AN ELECTRON BEAM. Shaptala, V. G.; Shevchenko, V. I. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 13: 398-406(Mar. 1968). (In Russian).

Excitation of electromagnetic waves is investigated in the plasma of a solid by a beam of fast electrons. The condition for arising instabilities and increments of increasing for helicons and Alfven waves are determined. It is shown that instability is also possible, with frequent plasma collisions. The influence of the finiteness of the semiconductor dimensions is investigated. (auth)

26469 PRELIMINARY ANALYSIS OF A SET OF DISLOCATION RIBBONS OBSERVED IN A GRAPHITE FOIL. Li, Ji-sheng; Kuan, Jo-nan; Ho, Yi-chen. Chin. J. Phys. (Peking) (Engl. Transl.), 21: 1119-25(Mar.-Apr. 1965).
Translated from Wu Li Hsueh Pao, 21: 875-9(Apr. 1965).

Transmission electron microscopic studies were made of graphite foils using diffraction and the dark field technique. Diffraction fringes of almost parallel dislocation lines were formed. Diffraction spots of the type (1010) formed three kinds of fringe intensities, while with (1120) spots, no such images were formed. The incomplete dislocation lines were found to be immobile, and various models to explain the results are considered. (D.L.C.)

26470 DIRECT OBSERVATION OF DISLOCATION NETWORKS AND MOIRE FRINGES IN GRAPHITE FOILS WITH AN ELECTRON MICROSCOPE. Kuan, Jo-nan; Li, Chi-sheng; Ho, I-djen. Chin. J. Phys. (Peking) (Engl. Transl.), 21: 850-7 (Mar.-Apr. 1965).
Translated from Wu Li Hsueh Pao, 21: 677-82(Mar. 1965).

Preliminary results are reported of various dislocation structures of graphite crystals from electron microscope observation. The observation was made by an East German Type SEM-3 electron microscope. The resolution power of the instrument is 20 to 30 Å. The high voltage used was 60 to 80 kilovolts. (auth)

26471 COMPUTER STUDIES OF FAST ION TRAJECTORIES IN CRYSTALS. Morgan, D. V.; van Vliet, D. (Cambridge Univ., Eng.). Can. J. Phys., 46: 503-16(Mar. 15, 1968).
From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

A computer program that follows the trajectories of fast ions in crystals is based on the assumption of classical dynamics and binary collisions. Initial work has been directed at various aspects of proton channeling in copper in the energy range 5 to 500 keV. The critical angle and distance of closest approach in a perfect lattice have been evaluated for both rows and planes and compare well with the predictions of the continuum model as developed by Lindhard (1965). The overlap of close-packed rows and planes and the modifications necessary to the basic theory when thermal vibrations are introduced are discussed. Experiments have been simulated directly by obtaining a statistical analysis of the velocity distribution of protons reflected from a (100) face of copper and transmitted through a thin (~1800 Å) crystal. In reflection, distinct minima were obtained along directions corresponding to close-packed rows and planes, in good agreement with experimental "blocking patterns" (Nelson 1967a). Transmission patterns also revealed a lack of large-angle scattering parallel to close-packed planes, analogous to the white arms observed experimentally with thinner crystals. (auth)

26472 INVESTIGATION OF THE ENERGY AND TEMPERATURE DEPENDENCE OF THE STRING EFFECT. Andersen, J. U.; Uggerhoej, E. (Univ. of Aarhus, Denmark). Can. J. Phys., 46: 517-25(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The temperature and energy dependence of the width of the axial dip in Rutherford scattering yield for energetic ions incident on a single crystal is investigated. The results are compared with numerical calculations on the basis of Lindhard's theory. In general, the agreement is quite satisfactory. A direct experimental demonstration of the reversibility rule is also presented. (auth)

26473 SCATTERING OF keV PROTONS FROM COPPER SURFACES. Behrisch, R. (Institut fuer Plasmaphysik GmbH, Munich). Can. J. Phys., 46: 527-35(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

For protons of 40 to 120 keV energy impinging on the surface of a copper single crystal, the energy and angular distributions of the backscattered hydrogen atoms were measured, especially in and around the ⟨100⟩ direction. (auth) (Canada)

26474 CHANNELING STUDIES THROUGH CHARACTERISTIC RADIATIONS. Brandt, W.; Dobrin, R.; Jack, H. Jr.; Laubert, R.; Roth, S. (New York Univ., N. Y.). Can. J. Phys., 46: 537-42 (Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The yield of K-shell fluorescence radiation emitted from aluminum crystals is measured during bombardment with $^{1}H^{+}$, $^{3}He^{+}$, $^{4}He^{+}$, and $^{20}Ne^{+}$ ions in the energy range 100 to 200 keV under channeling conditions. The yield as a function of the angle between the beam and a crystallographic direction shows a minimum; the half-width is independent of the ion mass and varies as the square root of the incident charge. Under proton bombardment the yield curve for copper K-shell excitation is somewhat wider than for L-shell excitation. The difference diminishes with increasing energy and vanishes near the upper end of our energy range. Channeling in organic crystals is demonstrated along the c direction of thin anthracene crystals in penetration experiments with 5.48-MeV alphas. The yield of optical fluorescence radiation emitted from the anthracene target during alpha bombardment shows a minimum when particles are incident along this channeling direction. (auth) (Canada)

26475 INFLUENCE OF LATTICE STRUCTURE ON MOTION OF POSITRONS AND ELECTRONS THROUGH SINGLE CRYSTALS. Uggerhoej, E.; Andersen, J. U. (Univ. of Aarhus, Denmark). Can. J. Phys., 46: 543-50(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The emission yield from single crystals doped with β emitters is investigated. In the axis direction, energetic electrons emitted from a lattice position show a peak in yield up to 2.4 times the normal yield, whereas positrons emitted from the same positions show a dip by a factor of 4 from the normal yield. Electrons emitted from interstitial positions show no peak in yield. Energetic electrons transmitted through a thin single crystal experience increased multiple scattering when the incoming beam is aligned with an axis direction. The influence of atomic planes on the motion of electrons and positrons is also investigated. Furthermore, the electron peak and positron dip have been used for the localization of foreign atoms in single crystals. (auth) (Canada)

26476 CHARGED-PARTICLE ENERGY LOSS IN THIN GOLD CRYSTALS. Gibson, W. M. (Univ. of Aarhus, Denmark. Bell Telephone Labs., Murray Hill, N. J.); Rasmussen, J. B.; Ambrosius-Olesen, P.; Andreen, C. J. Can. J. Phys., 46: 551-60(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The energy loss of 400-keV protons and 800-keV helium ions transmitted through thin gold crystals has been studied. The effects of mosaic spread in gold crystals grown on sodium chloride substrates and the effects of twinning in crystals grown in mica substrates are examined in detail. Conditions and measurements necessary to minimize such crystal effects are described. The directional dependence of the relative intensities of resolved components in the energy-loss spectra has been measured. The results are used to evaluate suggestions of the origin of structure in the energy loss of transmitted particles. (auth)

26477 CHANNELING OF MEDIUM-MASS IONS THROUGH SILICON. Eisen, F. H. (North American Rockwell Corp., Thousand Oaks, Calif.). Can. J. Phys., 46: 561-72(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The channeling of ions with $5 \leq Z_1 \leq 19$ through thin (0.24 to 1.5 μ) silicon samples has been studied for ion energies ranging from about 100 to 500 keV. The effects of radiation damage and sample misorientation on the energy spectrum and angular spread of the transmitted ions have been observed for ⟨110⟩ channeling, using ^{11}B projectile ions. Electronic stopping cross sections for well-channeled ions have been calculated from measurements of the maximum energy of the transmitted ions as a function of their incident energy. For ^{11}B these measurements have been made for channeling along the ⟨110⟩, ⟨112⟩, ⟨100⟩, and ⟨111⟩ axes and between the {111}, {110}, and {100} planes. The value of the electronic stopping cross section, S_e, for axial channeling ranged from 3.56×10^{-14} eV-cm^2/atom for the ⟨110⟩ axis to 4.88×10^{-14} eV-cm^2/atom for the ⟨111⟩ axis, at an ion velocity of 1.5×10^8 cm/sec. S_e was significantly higher for the {111} plane than for the ⟨110⟩ axis, but equal to S_e for the ⟨112⟩ axis. The values of S_e for the ⟨100⟩ and ⟨111⟩ axes and the {110} plane were nearly equal. For ions other than ^{11}B, S_e was determined for ⟨110⟩ channeling and was found to exhibit a strong oscillatory dependence on Z_1. For electronic stopping cross sections calculated at an ion velocity of 1.5×10^8 cm/sec, maxima in the S_e vs Z_1 curve occurred at $Z_1 = 6$ ($S_e = 4.34 \times 10^{-14}$ eV-cm^2/atom) and $Z_1 = 17$ ($S_e = 6.76 \times 10^{-14}$ eV-cm^2/atom). The minimum occurred at $Z_1 = 11$, where the value of S_e was 0.57×10^{-14} eV-cm^2/atom. (auth)

26478 RANGE MEASUREMENTS IN ORIENTED TUNGSTEN SINGLE CRYSTALS. III. THE INFLUENCE OF TEMPERATURE ON THE MAXIMUM RANGE. Davies, J. A.; Eriksson, L.; Whitton, J. L. (Chalk River Nuclear Labs., Ont.). Can. J. Phys., 46: 573-9(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The maximum range, R_{max}, of ^{42}K ions along the ⟨100⟩ axis in tungsten has been measured over the temperature region 30 to 725°K, by means of the anodizing/stripping technique. The results show that R_{max} is completely independent of the lattice temperature, within an experimental precision of ±3%. The prominent supertail (~10%) observed in ^{42}K range distributions at 30°K interferes with the evaluation of R_{max}. This tail, however, can be completely suppressed by subsequently bombarding the crystal with a higher dose (3×10^{15}/cm^2) of Ne ions of similar energy while still at ~30°K. The main conclusions derived from this series of three papers on range measurements in tungsten single crystals are briefly outlined. It is found that R_{max} is an extremely useful experimental parameter for characterizing the range distribution of channeled ions. Its value in tungsten is determined almost entirely by electronic stopping, except at energies less than a few keV. The electronic stopping powers derived from the energy dependence of R_{max} agree roughly with theoretical predictions; however, the observed stopping power values exhibit large oscillations about the smooth theoretically predicted dependence on Z_1, the atomic number of the projectile. An adequate explanation of these Z_1 oscillations is not yet available. (auth)

26479 THE DEPTH DISTRIBUTION OF 40-keV ^{133}Xe IONS IN VARIOUS SINGLE CRYSTALS. Whitton, J. L. (Chalk River Nuclear Labs., Ont.). Can. J. Phys., 46: 581-6(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The marked difference previously observed in the depth distribution profiles of 40-keV ^{133}Xe ions in the best channeling directions of tungsten and gold has prompted a more detailed investigation into the effect of various crystal properties on these profiles. It is found that the major differences are: (i) a much smaller fraction of the ions remains channeled in gold; (ii) a maximum range is observable in gold at 20°K but not at room temperature; and (iii) the maximum range in gold is much larger than in tungsten. The effects of crystal structure and of mean vibrational amplitude on the depth distribution have been studied. Depth-distribution profiles in gold resemble those in other similar fcc metals, such as copper and aluminum. On the other hand, in iridium, an fcc metal whose thermal vibrational amplitude is almost identical with that of tungsten and tantalum, the profiles resemble those in the bcc metals much more closely than those in the fcc metals. It is concluded that the mean vibrational amplitude of the lattice plays a major role in determining the depth-distribution profile, whereas the maximum range of channeled particles is determined mainly by the electron density along the mid-channel axis. (auth)

26480 IMPLANTATION PROFILES OF ^{32}P CHANNELED INTO SILICON CRYSTALS. Dearnaley, G.; Freeman, J. H.; Gard, G. A.; Wilkins, M. A. (Atomic Energy Research Establishment, Harwell, Eng.). Can. J. Phys., 46: 587-95(Mar. 15, 1968). (AERE-R-5649).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Concentration profiles of ^{32}P ions implanted into silicon crystals have been studied over the energy range 10 to 110 keV, using an electromagnetic separator. Beam directions near the major channeling axes ⟨110⟩ and ⟨111⟩ were chosen. After implantation, the profiles were determined by the method of anodic stripping, and the beta activity of each oxide layer removed was measured in a low-background proportional counter. Concentration profiles were studied as a function of the ion energy, crystal orientation, crystal temperature, and ion dose. Precise crystal orientation was achieved by a proton-channeling technique making use of protons of around 10 MeV energy from the Harwell tandem generator. The maximum penetration of channeled ions along the ⟨110⟩ axis was found to vary with the energy, E, approximately as $E^{0.6}$. Significant temperature effects were observed, and the influence of radiation damage on ion channeling was studied and is related to other observations. (auth)

26481 IMPURITY DISTRIBUTION PROFILES IN ION-IMPLANTED SILICON. Kleinfelder, W. J.; Johnson, W. S.; Gibbons, J. F. (Stanford Univ., Calif.). Can. J. Phys., 46: 597-606(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

A p–n junction location technique for determining ion-implanted profiles of dopant ions in semiconducting substrates is described. This method allows detection of the implanted concentration up to eight orders of magnitude below the peak. Distributions of boron, nitrogen, phosphorus, and arsenic ions implanted in ⟨111⟩ oriented silicon crystals as well as boron in ⟨110⟩ silicon crystals are given. The samples were implanted at energies from 10 to 70 keV and were annealed during implant at 625°C. The results are compared to theoretical estimates. In the cases of boron and arsenic in ⟨111⟩ silicon, and boron in ⟨110⟩ silicon, a definite maximum range R_{max} is apparent. In these cases R_{max} increases as the square root of the incident energy, indicating a channeling phenomenon. The phosphorus profiles do not show a maximum range, but rather decrease exponentially with depth for five orders of magnitude in concentration. (auth)

26482 THEORY OF CHARGED PARTICLES IN SEMICONDUCTORS. Brandt, Werner; Reinheimer, Julian (New York Univ., N. Y.). Can. J. Phys., 46: 607-12(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The dielectric response function of semiconductors is derived for an isotropic model characterized by an effective Fermi energy, E_F, corresponding to a mean valence electron density, and an energy gap of width E_g. The response to the fields set up by impurity atoms and by moving charged particles is investigated. The screening of impurities changes with the energy gap: as E_g increases from zero, the potential expands in range and approaches the bare Coulomb potential, while the Friedel oscillations in the induced electron density about the impurity are suppressed. The contribution of electronic excitations from the valence band of semiconductors to their stopping power for swift heavy particles is calculated. (auth)

26483 THERMAL RELEASE OF INERT GASES FROM TUNGSTEN: DEPENDENCE ON THE CRYSTAL FACE BOMBARDED. Kornelsen, E. V.; Sinha, M. K. (National Research Council of Canada, Ottawa). Can. J. Phys., 46: 613-19(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Flat (100), (110), and (211) faces of tungsten were bombarded in ultrahigh vacuum with inert-gas ions having energies up to 5 keV. The rate of release of the entrapped gas was then measured as the crystals were heated at 40°K/sec by electron bombardment. The spectra of release rate vs. temperature consist of a series of maxima, which show distinctive variations with the type, energy, and number of the incident ions and with the crystal face on which they impinge. Evidence is presented that the peaks at T < 1600°K are associated with gas atoms trapped within a few lattice constants of the crystal surfaces, the binding energies being determined by characteristic arrangements of the lattice atoms about the trapping site. The gas release at T > 1600°K is consistent with the diffusive motion of more deeply penetrating particles as impurities in the bulk of the crystal, the expected variations of penetration depth with energy and crystallographic direction being clearly evident. Evidence is also presented that for sufficiently high trapped neon atom concentrations, gas release can occur by the diffusive motion of two or three atom clusters. (auth)

26484 INERT GAS DIFFUSION AND RADIATION DAMAGE IN IONIC CRYSTALS AND SINTERS FOLLOWING ION BOMBARDMENT. Matzke, Hj. (Technical Univ. of Brunswick). Can. J. Phys., 46: 621-34(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

A review is given of radiation damage and diffusion phenomena in a large variety of ionic crystals (oxides and halides) and two metals following ion bombardment. Ion beams of both light and heavy nuclides between mass number 3 (tritium) and 222 (emanation) were employed. The ion doses varied between 10^4 and 10^{17} ions/cm^2. Four different experimental techniques were used to detect gross structural radiation damage following bombardment: reflection electron diffraction, measurement of ranges or penetration profiles, electron microscopy in transmission or using replica techniques, and gas release measurements at low temperatures. In general, materials having cubic lattice structures were shown to be more stable than anisotropic substances. Minor local damage (such as point defects, defect clusters or voids, dislocations, and loops) was studied by its interaction with rare gases or other volatile elements (Br, Rb, Cs). For the heavy rare gases (Kr, Xe, Em) and low bombardment doses, volume diffusion was observed starting between 0.4 and 0.5 of the melting point, T_m, on the absolute temperature scale. The activation enthalpies ΔH were about 80 ± 10% of those for the self-diffusion of the less mobile lattice ions and were related to T_m via $\Delta H = (1.4 \pm 0.2) \times 10^{-3}\ T_m$ eV = $(32 \pm 4)\ T_m$ kcal/mole. For the diffusion mechanism, a relation with self-diffusion is suggested, the gas most probably migrating in small vacancy clusters. (auth) (Canada)

26485 THERMAL DESORPTION OF GAS EMBEDDED IN COPPER SINGLE CRYSTALS. Jokic, T.; Perovic, B. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). Can. J. Phys., 46: 635-9(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Thermal gas-release characteristics of copper single-crystal specimens bombarded by a high-energy Xe^+ ion beam are presented. The influence of the crystallographic orientation of the targets bombarded, of the ion energy, and of the total ion dose from 10^{13} to 10^{18} ions/cm^2. Curves for fractional gas release were obtained by the method of stepwise thermal treatment, using the radioactive tracer technique. From the experimental data obtained and the theoretical expectations, corresponding activation energies for gas release were deduced. Thermal stability of the gas embedded in the target is discussed. (auth)

26486 IRRADIATION DAMAGE IN ALUMINUM SINGLE CRYSTALS PRODUCED BY 50-keV ALUMINUM AND COPPER IONS. Henriksen, L. (Univ. of Copenhagen); Johansen, A.; Koch, J.; Andersen, H. H.; Leffers, T.; Cotterill, R. M. J. Can. J. Phys., 46: 641-6(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Aluminum single crystals, thin enough to be examined by electron microscopy, have been irradiated with 50-keV aluminum and copper ions. The irradiation fluxes were in the range 10^{11} to 10^{14} cm^{-2} sec^{-1} and the doses were from 6×10^{12} to 6×10^{14} cm^{-2}. Irradiation along either a ⟨110⟩ or a ⟨111⟩ direction produces rows of dislocation loops all lying parallel to one particular ⟨110⟩ direction. If the aluminum target is quenched from 600°C and annealed at room temperature prior to irradiation with aluminum ions, the rows of loops are suppressed. The amount of damage observed is considerably less than would be expected from isotropic damage theory. (auth) (Canada)

26487 THE PENETRATION OF LATTICE DEFECTS IN COPPER AND GOLD FOILS BOMBARDED WITH 1 TO 5-keV ARGON IONS. Diehl, J.; Diepers, H.; Hertel, B. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Can. J. Phys., 46: 647-52(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Single crystalline copper and gold foils are bombarded with 1- to 5-keV argon ions. Transmission electron micrographs of

the bombarded foils show black spots caused by small interstitial agglomerates. Measurements of the spatial distribution of these agglomerates, carried out by means of a special stereo technique, indicate that the average distance of the agglomerates from the bombarded surface is much higher than the calculated range of the Ar ions. From the variation of the depth distribution of the agglomerates with the orientation of the foil and with the ion energy, it is concluded that the interstitial atoms that form the agglomerates penetrate into the lattice by means of focusing collisions. Tentative conclusions on the ranges of the focusing collision chains that transport matter (dynamic crowdions) are discussed. (auth)

26488 DEFECT STUDIES IN CRYSTALS BY MEANS OF CHANNELING. Boegh, E. (Chalk River Nuclear Labs., Ont.). Can. J. Phys., 46: 653-62(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Channeling of fast, light ions (e.g., protons and α particles) in crystals containing displaced atoms is discussed on the basis of Lindhard's theory, with the particular purpose of applying channeling as a tool for studying crystal defects. Measurements of the orientation dependence of the yield of close-encounter processes, such as nuclear reactions and wide-angle elastic scattering, can provide information about the depth distribution of structural defects in the first few microns beneath the surface of a single crystal. The relation between the yield and defect concentration is derived. This relation has led to a new double-alignment technique that combines channeling and blocking, and increases considerably the sensitivity for detecting structural defects. Scattering yield measurements in tungsten and silicon crystals covered with amorphous oxide layers of accurately known thickness are used to verify the results of the theoretical discussion. Double alignment is demonstrated. Criteria for selecting the optimal experimental conditions are set up. The sensitivity of the method for detecting lattice disorder corresponds to the displacement of $\sim 10^{14}$ to 10^{15} atoms per cm^2 (i.e. less than one atomic layer); the depth resolution with which, for example, radiation damage may be determined is ~50 Å. (auth)

26489 ION IMPLANTATION OF SILICON AND GERMANIUM AT ROOM TEMPERATURE. ANALYSIS BY MEANS OF 1.0-MeV HELIUM ION SCATTERING. Mayer, J. W.; Eriksson, L.; Picraux, S. T.; Davies, J. A. (Chalk River Nuclear Labs., Ont.). Can. J. Phys., 46: 663-73(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The orientation dependence of the backscattered yield of 1.0-MeV helium ions has been used to investigate the lattice characteristics of silicon and germanium implanted at room temperature with 40-keV heavy ions (Ga, As, Sb, In, P). The method gives directly the number of substrate atoms displaced from their lattice sites by more than the Thomas–Fermi screening distance (≈0.2 Å) and also the location of the implanted atoms. Each heavy ion is found to displace several thousand lattice atoms in a localized region around its track. At doses where the individual disordered regions do not overlap ($\sim 10^{13}$ ions/cm^2, or less), the silicon lattice reorders at 260°C and the germanium lattice at 180°C. At doses greater than $\sim 10^{14}$ ions/cm^2, a completely amorphous layer is formed in both silicon and germanium. During annealing, the reordering of the lattice is initiated at the interface between the amorphous region and the underlying crystal. The reordering of this amorphous layer occurs at significantly higher temperatures (570°C in Si and 380°C in germanium) than those required for the isolated disordered regions. At doses much greater than 10^{15}/cm^2, even higher anneal temperatures are required. Following a room-temperature implantation, each implanted atom is embedded in a highly disordered region (at least, for doses > 10^{14}/cm^2) and consequently the backscattered spectra from these atoms do not show orientation effects. As the lattice reorders during annealing, the number of implanted atoms lying along the ⟨111⟩ lattice row increases. Following anneal, ~75% of the As atoms and ~90% of the Sb atoms are found on substitutional sites in silicon, while in germanium, ~80% of the In atoms are found on substitutional sites. Annealing to higher temperatures (700 to 900°C in the case of silicon) often causes the number of substitutional atoms to decrease again, owing to the effect of internal precipitation or diffusion to the surface. (auth)

26490 ELECTRICAL AND PHYSICAL MEASUREMENTS ON SILICON IMPLANTED WITH CHANNELED AND NONCHANNELED DOPANT IONS. Gibson, W. M. (Univ. of Aarhus, Denmark. Bell Telephone Labs., Murray Hill, N. J.); Martin, F. W.; Stensgaard, R.; Jensen, F. Palmgren; Meyer, N. I.; Galster, G.; Johansen, A.; Olsen, J. S. Can. J. Phys., 46: 675-88(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Hall effect and resistivity measurements from room temperature to 4.2°K have been carried out on silicon samples implanted with 400-keV phosphorus, lithium, and boron ions. Implantations were carried out at 25°C in random as well as precisely controlled channeling directions, and the electrical measurements were made after successive annealing treatments. These measurements are interpreted in terms of the final lattice position of the injected impurity ions and the amount and type of crystal defects produced during the implantation and are correlated with physical measurements of lattice position and radiation damage studied by using nuclear-reaction, beta-particle emission, and Rutherford-scattering techniques. (auth)

26491 INFLUENCE OF TEMPERATURE AND CHANNELING ON ION-BOMBARDMENT DAMAGE IN SILICON. Nelson, R. S.; Mazey, D. J. (Atomic Energy Research Establishment, Harwell, Eng.). Can. J. Phys., 46: 689-94(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

The ion bombardment of silicon results in the formation of an amorphous phase in the vicinity of the bombarded regions. This gives rise to a milky appearance, which is easily distinguishable from an adjacent unbombarded region. Experiments are described, which were designed specifically to study the influence of bombardment temperature and channeling on the formation of this phase. (auth)

26492 RADIATION DAMAGE AND SUBSTITUTIONAL CHEMICAL IMPURITY EFFECTS IN SINGLE-CRYSTAL GERMANIUM BOMBARDED WITH 40-keV B^+, Al^+, Ga^+, Ge^+, P^+, As^+, AND Sb^+ IONS. Alton, G. D.; Love, L. O. (Oak Ridge National Lab., Tenn.). Can. J. Phys., 46: 695-704(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Isochronal anneal studies have been made on n- and p-type germanium bombarded with germanium and several substitutional impurities, using the four-point and thermoelectric probes as means of indicating changes in sheet resistivity and majority carrier type. Electrical properties of diodes made from type-converted samples were also determined. All bombardments were performed at 40 keV in a 24-in.-radius electromagnetic isotope separator at room temperature. These studies revealed the following: (1) Heavy-particle bombardment of germanium introduces acceptor states regardless of the identity of the bombarding species. (2) Annealing curves for n-type germanium indicate a two-stage process; details of the annealing process are dependent on the ion species used and the crystal orientation bombarded. (3) There is a crystallographic and mass dependence on the amount of change in sheet resistivity produced in n-type germanium. (4) Type-conversion temperatures in p-type germanium were observed to occur at 450 to 475°C for phosphorus, ~500°C for arsenic, and slightly greater than 500°C for antimony, suggesting that the ease of moving a particular species into an active lattice position is related to its atomic size. (5) Voltage–current and capacitance measurements indicate that large-area diodes of relatively good properties and reproducibility can be made by ion implantation in germanium. (auth) (Canada)

26493 INFLUENCE OF TEMPERATURE ON PHOSPHORUS ION BEHAVIOR DURING SILICON BOMBARDMENT. Glotin, Philippe M. (CEN, Grenoble, France). Can. J. Phys., 46: 705-12(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Silicon samples have been bombarded with 20-keV phosphorus ions along the easy channeling direction. Annealing temperatures and activation energies of the defects created during irradiation have been determined using a Corbino structure. The nature of the defects varies as a function of depth. Large clusters exist in the superficial layers when mainly E and A centers have been identified in the channeled part of the profile. The influence of these defects on ion ranges is shown. The most important consequence of this study is to indicate a useful temperature range, between 550 and 650°C, for phosphorus implantation into silicon. (auth)

26494 ION-BOMBARDMENT-INDUCED RESISTIVITY CHANGES IN THIN FILMS OF SILVER, GOLD, TITANIUM, AND TUNGSTEN. Navinsek, B. (Josef Stefan Inst. of Nuclear

Science, Ljubljana, Yugoslavia); Carter, G. Can. J. Phys., 46: 719-23(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Energetic argon ions were injected into thin films (100 to 500 Å) of Ag, Au, Ti, and W, and changes in the electrical resistance of the films were observed. Three stages in the resistance change/ion dose relation were observed. The first at low ion doses, where the resistance falls, is believed to be a result of removal of contaminant gas from the surface. The next stage at higher ion doses, where the resistance increases to a quasi-constant value, is believed to be associated with damage production at and near the film surface. At still higher ion doses, the resistance increases to infinity as a result of sputtering of the film. (auth)

26495 THERMAL RELEASE OF RARE GASES IMPLANTED IN METAL TARGETS BY HIGH-ENERGY ION BOMBARDMENT. Rickers, G.; Soerensen, G. (Univ. of Aarhus, Denmark). Can. J. Phys., 46: 725-30(Mar. 15, 1968).

From Conference on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ont. See CONF-670966.

Results of thermal gas release from copper, silver, and gold targets bombarded with krypton and xenon ions of energies between 20 and 450 keV are presented. The influence of bombardment doses is shown. The desorption carried out under high-vacuum conditions was examined with the tracer technique, and the fractional release was determined as a function of temperature, energy, and dose. Depth distributions were studied using a corrosion film technique, and the correlation between such distributions and the gas release was investigated. The results are compared with earlier work, and an attempt to elucidate inert-gas diffusion in copper is described. (auth)

26496 ORDER–DISORDER AND RADIATION DAMAGE. Rudman, Peter S. (Battelle Memorial Inst. Columbus, Ohio). pp 405-27 of Intermetallic Compounds. Westbrook, J. H. (ed.). New York, John Wiley and Sons, Inc., 1967.

Long-range order (LRO) is considered first. A general approach to LRO definition and its diffraction determination for arbitrary systems is developed. The definition of short-range order (SRO) and its determination by x-ray diffraction are considered next. Two approaches are compared. A new derivation of the SRO x-ray diffuse scattering equation is given. The somewhat related problems of order-disorder transformation kinetics and high-energy radiation disordering are reviewed. 94 references. (M.H.R.)

26497 PROPOSED DETECTION OF DYNAMICALLY ORIENTED NUCLEI BY ACOUSTIC NUCLEAR MAGNETIC RESONANCE. Breitbart, Mary Duns Scotus (St. Louis Univ.); Barker, W. A. J. Acoust. Soc. Amer., 41: 557-63(1967).

It is possible to observe NMR by an acoustic technique, as has been demonstrated on such nuclei as ^{23}Na, ^{79}Br, ^{115}In, ^{121}Sb, ^{123}Sb, and ^{127}I. The acoustic type of NMR is referred to as ANMR to distinguish it from the conventional type CNMR. It is proposed that ANMR be used to detect steady-state nuclear orientation achieved by the Jeffries–Abragam effect. This is a new scheme for double magnetic resonance (ADMR) in contrast with conventional DMR, which employs the usual time-varying magnetic field to observe the enhancement of the nuclear resonance. The acoustic wave modulates the nuclear quadrupole interaction to induce double as well as single spin flips. Calculations for nuclei of spin $I = 3/2$ in weak dipolar coupling with paramagnetic electrons of spin $S = 1/2$ in an axial crystal indicate that both types of DMR should give positive and negative enhancements $\sim g|\beta|/g_n\beta_n \sim 10^3$ for $1° \leq T \leq 300°K$ in favorable circumstances. Suitable samples in which the effect might be demonstrated are iodine nuclei in NaI containing I_2^- centers and ^{27}Al nuclei in Cr^{3+} or V^{3+} doped Al_2O_3. If the related experiments are performed, the effect of the electron paramagnetic resonance linewidth and of nuclear-spin diffusion may well reduce the enhancement by 1 or 2 orders of magnitude. (BBB)

26498 SOME ELECTRICAL AND MAGNETIC PROPERTIES OF COMPOUNDS OF RARE EARTHS AND ACTINIDES. Lallement, R. (CEN, Fontenay-aux-Roses, France). Proc. Brit. Ceramic Soc., No. 10, 115-28(Mar. 1968).

The electrical resistivity, thermoelectric power, and magnetic susceptibility at low temperatures of several rare-earth and actinide compounds, mainly carbides and nitrides, were measured. The rare earth carbides (face-centered cubic NaCl type) were magnetically ordered at low temperatures. The transport properties, and the variations of the Curie-Weiss paramagnetic temperature with stoichiometry, are interpreted on the basis of a coupling between M^{3+} ions via the conduction electrons, the carbon atoms acting as electron donors. Magnetic order at low temperatures was also found for several actinide compounds. The problem of the magnetism of these compounds was more complex than in the rare earth case. Evidence was found of the influence of the local configuration of the metalloid atoms on the moments of the actinide atoms, but a clear picture of the magnetism of the actinide compounds was not obtained. (auth) (UK)

26499 RELAXATION OF ^{161}Dy AND ^{163}Dy NMR IN Dy METAL. Gill, D.; Kaplan, N. (Univ. of California, Santa Barbara). Phys. Lett., 26A: 505-7(Apr. 8, 1968).

NMR relaxation measurements on two transitions of ^{161}Dy and ^{163}Dy in Dy metal show (1) $TT_1 \geq 9 \times 10^{-3}$ sec °K below 4.2°K and (2) T_2^{-1} arises mainly from spin–lattice processes. The dominant relaxation mechanism should involve 4f electrons. (auth)

26500 CRYSTAL FIELD SPLITTING OF Yb^{3+} IN CUBIC SITES IN CALCIUM FLUORIDE. Baker, J. M.; Blake, W. B. J.; Copland, G. M. (Oxford Univ.). Phys. Lett., 26A: 504-5 (Apr. 8, 1968).

ENDOR measurements of the nuclei of Yb^{3+} in cubic sites in CaF_2 enable one to measure parameters which arise from second-order couplings to the excited Γ_8 state of the ground $J = 7/2$ manifold, and hence give the energy of the Γ_8 state as 604 ± 10 cm^{-1}. (auth)

26501 MOESSBAUER EFFECT MEASUREMENT OF THE VANADIUM MOMENT IN ORDERED AND DISORDERED PHASES OF Au_4V. Cohen, R. L.; Sherwood, R. C.; Wernick, J. H. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Lett., 26A: 462-3(Apr. 8, 1968).

Using the Mössbauer effect in ^{197}Au, the internal field at the gold nuclei in Au_4V and Au_4Mn were measured. Combining the results in the two systems lead to a value of 0.92 μ_B for the moment on the vanadium ions in the ordered phase Au_4V. (auth)

26502 NUCLEAR MAGNETIC RESONANCE DETERMINATION OF THE ^{125}Te HYPERFINE FIELD IN FERROMAGNETIC $CuCr_2Te_4$. Berger, S. B. (RCA Labs., Princeton, N. J.); Budnick, J. I.; Burch, T. J. Phys. Lett., 26A: 450-1(Apr. 8, 1968).

In $CuCr_2Te_4$, a direct measurement yields for ^{125}Te a hyperfine field of 188 kOe at 1.4°K which is directed opposite to the sample magnetization. Our value of the field disagrees with a previous indirect Mössbauer determination. (auth)

26503 ^{59}Co NMR IN Co^{2+} ION AT TETRAHEDRAL SITE. Tsuda, T. (Kyoto Univ.); Hirai, A.; Abe, H. Phys. Lett., 26A: 463-4(Apr. 8, 1968).

Cobalt-59 NMR in Co^{2+} ion at tetrahedral site was observed on powdered $CoCr_2O_4$ and its hyperfine field was about (-)62.7 kOe. (auth)

26504 ANISOTROPY IN THE MIXED STATE THERMAL CONDUCTIVITY OF NIOBIUM. Lowell, J.; Sousa, J. B. (Oxford Univ.). Phys. Lett., 26A: 480-1(Apr. 8, 1968).

The thermal conductivity of pure Nb in the mixed state depends strongly on the angle between the heat flow and the fluxoids. At high temperatures the flux line direction is the direction of maximum conductivity, but at low temperatures the conductivity is maximum in the perpendicular direction. (auth)

26505 EXPERIMENTAL STUDIES OF POLARIZATION EFFECTS IN SPIN-WAVE SCATTERING OF NEUTRONS. Riste, T.; Moon, R. M.; Koehler, W. C. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett., 20: 997-9(Apr. 29, 1968).

Polarization effects in the spin-wave scattering of thermal neutrons were studied. In the case of a ferromagnet a study is made of the polarization created along the scattering vector when an initially unpolarized beam is scattered. Also the partial or complete rotation of the polarization vector when an initially polarized beam is scattered by spin waves in a ferromagnet and in an antiferromagnet was observed. (J.F.P.)

26506 ISOMER SHIFTS OF IMPURITY ^{119}Sn NUCLEI IN SOME SEMICONDUCTING COMPOUNDS. Chekin, V. V.; Vinnikov, A. P.; Balkashin, O. P. (Physical-Technical Inst. of Low Temperatures, Kharkov). Sov. Phys.-Solid State (Engl. Transl.), 9: 2354-5(Apr. 1968).

Translated from Fiz. Tverd. Tela, 9: 2992-3(Oct. 1967).

The isomer shift characterizing changes in the effective density of the s-electrons of ^{119}Sn impurity nuclei (≈1 at. %) was determined in compounds InSb, GaSb, AlSb, ZnTe, CdTe, In_2Te_3, Bi_2Te_3, PbSe, SnTe, SnSe, $SnSe_2$, SnSb, and in solid solutions of the binary systems Se–Te and Bi–Sb. The results are discussed briefly in relation to chemical binding, electric properties, and lattice position of the impurity. (A.G.W.)

26507 CHANGING OF CONDUCTIVITY AND THE OPTICAL ABSORPTION OF FLUORITE DUE TO IRRADIATION IN REAC-

TOR AND SYNCHROCYCLOTRON. Vladimirskii, Yu. B.; Zakharov, G. M.; Nikitinskaya, T. I.; Tyutin, M. S. (Leningrad Polytechnic Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 11, 51-4(1967). (In Russian).

Changes of the optical absorption coefficient and the electroconductivity of pure and oxygen-containing crystals of fluorite after irradiation in a reactor and by a 660-MeV proton beam were reported. It was established that the conductivity of pure crystals is not changed, but the conductivity of oxygen-containing crystals is decreased. The optical absorption of irradiated pure and oxygen-containing crystals differ insignificantly. On the basis of these data, conclusions were made on the absence of a single mechanism for the processes, leading to coloration and to the reduction of the conductivity of the oxygen-containing fluorite crystals. (tr-auth)

26508 RADIATIVE RECOMBINATION AT RADIATION DEFECTS IN SILICON. Bortnik, M. V.; Tkachev, V. D.; Yukhnevich, A. V. (Lenin Belorussian State Univ., Minsk). Sov. Phys.-Semiconduct. (Engl. Transl.), 1: 290-4(Sept. 1967).

The radiative recombination spectra of Si single crystals containing radiation defects produced by γ irradiation were examined. Two groups of bands, of different profiles with different temperature dependences, were observed in the impurity region of the spectrum. Analysis of the results indicated that two mechanisms of radiative recombination are possible in Si: the recombination of free carriers and the recombination with the participation of localized states. In the latter case, exciton complexes, consisting of an impurity center and a localized carrier, were active. The experimental data indicated that the energy structure of these exciton complexes was relatively simple. The detection of a group of bands in the impurity recombination spectrum of γ-irradiated material at 77°K suggested the possibility of making a semiconductor laser using impurity transitions in Si. The existence of no-phonon lines and the use of low temperatures would facilitate the solution of this problem. Moreover, the establishment of a relation between the observed bands and chemical impurities in the crystal makes it possible to develop a method for qualitative analysis of residual impurities in Si single crystals, based on a preliminary irradiation of the material and an investigation of its impurity recombination radiation spectrum. (BBB)

26509 METHOD FOR THE DETERMINATION OF MAGNETIC STRUCTURES FROM NEUTRON DIFFRACTION DATA BY THE USE OF A SPIN DENSITY PATTERSON FUNCTION. Wilkinson, C. (Cavendish Lab., Cambridge, Eng.). Phil. Mag., 17: 609-21 (Mar. 1968).

The Patterson method, which has been widely used in the solution of x-ray structure problems, may also be used to solve magnetic structures when the unpolarized neutron intensities of magnetic reflections are used as coefficients in the summation. The peak in the spin density Patterson function due to atoms m and n with magnetic moments S^m and S^n has a height proportional to $S^m \cdot S^n$ and is elongated in the direction that bisects the angle between the moment directions. The method has been successfully tested on known examples of magnetic structures, and has been used by Yessik (1968) to solve the previously unknown structure of the antiferromagnetic Mn_2P. (auth) (UK)

26510 CERIUM-STABILIZED UO_2^{+2}:Nd^{+3} LASER GLASS. Greenberg, C. B.; French, P. W. (Pittsburgh Plate Glass Co., Pittsburgh). J. Opt. Soc. Amer., 58: 472-5(Apr. 1968).

The ground-state absorption at 1.06 μ in UO_2^{+2}: Nd^{+3} laser glass is directly related to the uranium content of the glass. Valence reduction of UO_2^{+2} to U^{+5} (and possibly U^{+4}) is responsible; however, the oxidized state can be stabilized with cerium. The percentage of the total uranium present as the UO_2^{+2} species was increased from 63% to 91% in a particular soda-lime-silica base. (auth)

26511 MAGNETIC AND CRYSTALLOGRAPHIC PROPERTIES OF SOME RARE EARTH COBALT COMPOUNDS WITH $CaZn_5$ STRUCTURE. Velge, W. A. J. J.; Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys., 39: 1717-20(Feb. 15, 1968).

The magnetic and crystallographic properties of $CaZn_5$-type intermetallic compounds of cobalt and rare-earth elements (including Th) have been investigated. Strong deviations from 1:5 stoichiometry are observed when the rare-earth radius becomes relatively small. Both the saturation magnetizations ($4\pi I_s$ = 2360–12,300 G) and the crystalline anisotropies (H_A = 25–210 kOe) depend on the rare-earth component. The coercive forces have been studied as a function of the milling time. For $SmCo_5$ and $GdCo_5$ $_{II}H_c$ values larger than 13,000 Oe are observed. These high values are possibly due to small structural details in $SmCo_5$ and $GdCo_5$, if compared to the other compounds. First experiments for making permanent magnets by pressing fine powders of $SmCo_5$ in a magnetic field have led to an energy product of 8.1×10^6 G Oe; the corresponding value for $_BH_c$ is 5200 Oe. (auth)

26512 A MOESSBAUER AND X-RAY DIFFRACTION STUDY ON THE CATION DISTRIBUTION IN $FeAl_2O_4$. Yagnik, C. M.; Mathur, H. B. (National Chemical Lab., Poona, India). J. Phys., C, 1: 469-72(Apr. 1968).

The Moessbauer spectrum of $FeAl_2O_4$ consists of three absorption peaks at 0, 1.46 and 2.56 mm s^{-1} relative to a $^{57}Co/Cu$ source. The spectrum can be resolved into two quadrupole-split spectra. The outer pair of lines corresponds to a quadrupole splitting of 2.76 ± 0.10 mm s^{-1} and an isomer shift of 1.52 ± 0.10 mm s^{-1} and may be attributed to the Fe^{2+} ions at the B sites. The inner doublet, with a quadrupole splitting of 1.39 ± 0.10 mm s^{-1} and an isomer shift of 1.10 ± 0.10 mm s^{-1}, can be attributed to the Fe^{3+} ions at the A sites. The degree of inversion x was determined from the relative areas under the two spectra to be 23 ± 2%. This is in agreement with the value of 25% determined from the intensities of the x-ray-diffraction powder pattern. (auth) (UK)

26513 EXISTENCE OF A CRITICAL LINE IN FERROMAGNETIC TO PARAMAGNETIC TRANSITIONS. Arrott, A. (Ford Motor Co., Dearborn, Mich.). Phys. Rev. Lett., 20: 1029-31 (May 6, 1968).

A possible connection is shown between a theorem due to Griffiths and a conclusion of van der Hoeven, Teaney, and Moruzzi about the critical magnetic properties of EuS. (auth)

26514 THE INFLUENCE OF ATOMIC SPIN FLUCTUATIONS IN TIME ON MOESSBAUER SPECTRA. Wegener, H.; Ritter, G. (Univ., Erlangen, Ger.). Z. Angew. Phys., 24: 270-7(Apr. 1968). (In German).

In paramagnetic and magnetically ordered materials the time fluctuation of the atomic spin causes a fluctuation of the magnetic hyperfine field. In the first part of this report the observable effects on the Moessbauer spectrum of $FeNH_4(SO_4)_2 \cdot 12H_2O$ are presented. The results are discussed in the framework of a spin wave model. In the second part various relaxation models (spinflip models, second order perturbation calculations of E. Bradford and W. Marshall) are compared with each other. Finally some experimental results are discussod. (auth)

26515 MAGNETIC SUSCEPTIBILITY AND EPR STUDY OF RARE EARTHS DILUTED IN $LaRu_2$. Cottet, H.; Donze, P.; Dupraz, J.; Giovannini, B.; Peter, M. (Univ., Geneva). Z. Angew. Phys., 24: 249-54(Apr. 1968).

A system of metallic lattice ($LaRu_2$) plus magnetic impurities (Gd^{3+}) coupled by an exchange interaction is described by a molecular field model both for the static susceptibility and the EPR properties. The relaxation terms introduced by Hasegawa are modified to satisfy the basic requirement that the EPR energy absorption must be positive for all values of the exchange coupling constant λ_{is}. Both the static susceptibility and the EPR results are fitted with the same value of λ_{is}. The low-temperature behavior of the EPR results is used to estimate the electron lattice relaxation rate δ_{sl}. (auth)

26516 KNIGHT SHIFT IN METALS. Luetgemeier, H. (Forschungslaboratorium, Erlangen, Ger.). Z. Angew. Phys., 24: 246-8(Apr. 1968). (In German).

A short review is given of the measurement of Knight-shift in anisotropic metals and the relation between the magnetic susceptibility and the Knight-shift in different intermetallic compounds. Some results on the Knight-shift in superconductors in the normal and the superconducting states are discussed. (auth)

26517 SPIN-DENSITY SPACE OSCILLATIONS AND HYPERFINE INTERACTION IN $RbCoF_3$. Petrov, M. P.; Nedlin, G. M. (Semiconductor Inst., Leningrad). J. Appl. Phys., 39: 1012-14(Feb. 1, 1968).

An experimental investigation of NMR on the ^{19}F, ^{87}Rb, ^{59}Co nuclei in polycrystalline $RbCoF_3$ has been performed. From these data the spin-density distribution was obtained in the discrete points of the crystal and it was found that the spin density oscillates, and a change of sign is observed in the space between the F^- and Rb^+ ions. The spin density was examined theoretically on the ^{19}F and ^{87}Rb ions taking into consideration that the ground state of Co^{2+} in $RbCoF_3$ is the superposition of $(e_g^4 t_{2g}^2)$ and $(e_g^2 t_{2g}^4)$ states. Most attention was paid to the successive definition of the spin density when it was necessary to account for the spin-orbit coupling in a paramagnetic ion. This question had not been considered earlier. The negative sign of the spin density on ^{87}Rb implies the predominant role of bonding orbitals in the hyperfine interaction. (auth)

26518 NMR OF ^{53}Cr AND ^{77}Se IN FERROMAGNETIC CHALCOGENIDE SPINELS. Berger, S. B. (Radio Corp. of America,

Princeton, N. J.); Budnick, J. I.; Burch, T. J. J. Appl. Phys., 39: 658-60(Feb. 1, 1968).

The NMR of ^{53}Cr nuclei has been observed in ferromagnetic $CdCr_2Se_4$, $CdCr_2S_4$, and $HgCr_2Se_4$ at 4.2°K using spin-echo and cw techniques. The spectra are complex with a principal triplet and have been analyzed considering coaxial anisotropic hyperfine and electric quadrupole fields of comparable magnitude to be acting on the chromium nuclei in randomly oriented domains. An excellent fit has been obtained between the calculated spectrum and spin-echo data. For $CdCr_2Se_4$, $CdCr_2S_4$, and $HgCr_2Se_4$, the separation between the outer components of the triplet is 1.76, 1.90, and 1.96 MHz, the isotropic part of the hyperfine field is −182.6, −191.0, and −178.3 kOe and the anisotropic component of the hyperfine field is +2.33, +2.07, and +2.3 kOe, respectively. The signs of the hyperfine field components indicate their direction with respect to the magnetization and were determined by measuring the frequency shift with applied magnetic field. The NMR of ^{77}Se nuclei has also been observed in $HgCr_2Se_4$ and $CdCr_2Se_4$ at 4.2°K. The spectra are consistent with the model of randomly oriented domains and exhibit a strongly anisotropic hyperfine field. The origin of the spectra and the sign of the hyperfine field components were determined by measuring the frequency variation of the spectra with applied magnetic field. (auth)

26519 MOESSBAUER RESONANCE OF ^{57}Fe IN OXIDIC SPINELS CONTAINING COPPER AND IRON. Evans, B. J.; Hafner, S. S. (Univ. of Chicago). J. Appl. Phys., 39: 694-5 (Feb. 1, 1968).

The Moessbauer resonance of ^{57}Fe in tetragonal and cubic phases of the spinel copper ferrite ($CuFe_2O_4$) has been investigated between 4.2° and 1000°K. Complementary experiments have been performed on the spinel systems $Cu_{1-x}Zn_xFe_2O_4$ and $Cu_{1-x}Cd_xFe_2O_4$, with $0 \leq x \leq 0.5$. At 4.2°K, at least two nonequivalent six-line patterns, I and II, are resolved in the spectra of all phases, exhibiting a combined magnetic and electric hyperfine interaction. The isomer shifts, internal magnetic fields, and nuclear quadrupole splittings have been determined as a function of temperature. At higher temperatures, below the Néel point, the cubic phases show an apparent six-line pattern with lines of non-Lorentzian shape and unusually broad half-widths. Above the Néel temperature, a distinct electric quadrupole splitting was observed in the spectra of the tetragonal phases while the cubic phases show an apparent one-line pattern of a complex shape. (auth)

26520 NMR RESULTS FOR THE SINGLET GROUND STATE OF Fe IN Cu. Welsh, L. B.; Heeger, A. J.; Jensen, M. A. (Univ. of Pennsylvania, Philadelphia). J. Appl. Phys., 39: 696-7 (Feb. 1, 1968).

Nuclear magnetic resonance studies of the Fe impurity contributions to the ^{63}Cu linewidth indicate the ground state of the magnetic impurity problem is nonmagnetic. The contribution of the Fe impurities to the ^{63}Cu longitudinal nuclear relaxation times is found to depend on the square of the Fe concentration. (auth)

26521 NUCLEAR MAGNETIC RESONANCE AND MAGNETIZATION STUDIES OF $CdCr_2Se_4$. Stauss, G. H. (Naval Research Lab., Washington, D. C.); Rubinstein, M.; Feinleib, J.; Dwight, K.; Menyuk, N.; Wold, A. J. Appl. Phys., 39: 667-8(Feb. 1, 1968).

The NMR lineshapes and temperature dependences of ^{53}Cr and ^{77}Se in the ferromagnetic spinel $CdCr_2Se_4$ were investigated. The internal magnetization directions are determined by shape anisotropy, so that the observed lineshapes are powder patterns extensively broadened by anisotropic dipolar and (for ^{53}Cr) quadrupolar interactions. The 0°K values for the central frequencies are 44.0 and 80 MHz for ^{53}Cr and ^{77}Se, respectively. The temperature dependence of the bulk magnetization was carefully measured and is in close agreement with that of the ^{53}Cr (or ^{77}Se) resonance frequency. The ^{53}Cr resonance signal could not be followed above 120°K because of increasingly rapid relaxation. Up to 100°K the dependence is described by $M = M_0 (1 - 3.11 \times 10^{-4} T^{\frac{3}{2}})$. Although the absence of other terms in T is not understood, the $T^{\frac{3}{2}}$ coefficient is derivable from a simple spin-wave calculation on the basis of the approximate model with two exchange interactions given by Baltzer, Wojtowicz, Robbins, and Lopatin. (auth)

26522 NMR STUDY OF FERROMAGNETIC RARE EARTH METALS AND ALLOYS. Itoh, J.; Kobayashi, S.; Sano, N. (Osaka Univ.). J. Appl. Phys., 39: 1325-6(Feb. 1, 1968).

NMR of several rare earth elements were observed in ferromagnetic rare earth metals and alloys. Generally, the observed lines were split by a nuclear electric quadrupole interaction. By analyzing the observed changes of the magnetic and electric quadrupole hyperfine interactions of Tb and Dy in alloy systems of Tb−Dy, Tb−Gd, and Dy−Gd, as compared with those in pure metals, it is concluded that there exists a considerable contribution of conduction electron polarization to the magnetic hyperfine interaction and that of crystalline field to the quadrupole interaction. T_1 and T_2 of Dy in Dy metal were measured and it is suggested that Pincus−Winter mechanism and Suhl−Nakamura interaction contribute to T_1 and T_2, respectively. (auth)

26523 IRRADIATION EFFECTS ON MAGNETIC PROPERTIES IN ORDER-DISORDER ALLOY Ni_3Fe. Gruzin, P. L.; Kharlamov, Yu. S. At. Energ. (USSR), 24: 48-52(Jan. 1968). (In Russian).

The effect of reactor radiation at 80°C on the magnetic properties (maximum magnetic permeability and coercive force) of the order−disorder alloys Ni_3Fe, Ni_3Fe-B, and Ni_3Fe-U was investigated. During irradiation of the alloy Ni_3Fe with the integral flux of 2.2×10^{16} to 8.6×10^{16} slow neutrons/cm² (the ratio of fast and thermal neutrons was equal to 1/4) substantial changes in the permeability and coercive force were observed. During irradiation of alloys with additions of 0.02 at. % B with a flux of 6.5×10^{16} slow neutrons/cm² a significantly larger change of the magnetic properties in comparison with nonalloyed alloys was generated. This change is probably connected with the acceleration of the ordering processes in at the thermal peaks, originating during slowing down of the α particles and recoil ^7Li. The magnetic properties of alloys with higher concentrations of B (~0.6 at. %) and alloys with additions of U (~1 at. %) do not change under irradiation. During annealing the ordering processes in the irradiated samples proceed with a higher rate than in nonirradiated samples; moreover, the temperature for the beginning of the ordering process is reduced. Both of these appear to be connected with the presence in the irradiated samples of point defects. (tr-auth)

26524 HIGH-RESISTANCE REGIONS IN SILICON IRRADIATED WITH PROTONS. Bulgakov, Yu. V.; Kolomenskaya, T. I. (Moscow State Univ.). Sov. Phys.-Semiconduct. (Engl. Transl.), 1: 346-9(Sept. 1967).

The depth dependence of the resistivity ρ in Si samples irradiated with 6.3-MeV protons was studied. It was established that the greatest changes in ρ occurred at the ends of the proton paths, the results obtained being explained on the basis of a theory of radiation damage of solids, taking into account the energy spectrum of the levels of defects generated by protons. The calculated values of the cross section for the formation of a knocked-out atom σ_d, the average coefficient for the multiplication of knocked-out particles $\bar{\nu}$, and the efficiency of defect generation n_d are tabulated for some values of the proton energy E_p. The dependence of the rectified path of particles t on their energy was found from data for Al. Extrapolation of the range−energy curve to low proton energies was carried out using the Fermi−Teller theory. The data showed that the curve representing the efficiency of defect generation has a strong maximum, of about 1 μ width, near the end of a particle path. However, because of the scatter in particle paths, the defect distribution curve had a broader maximum. Using the calculated distribution of radiation defects, the dependence of the resistivity on the depth was determined. When Si is irradiated with protons, ir absorption bands appear and these bands correspond to A and E centers, known from experiments with electron bombardment. It has been established that these centers correspond to $E_c - 0.17$ eV and $E_c - 0.4$ eV levels in the forbidden band. The dependences $\rho(x)/\rho_0$, calculated for these levels, are given. The calculations and experimental data agreed for $k_1 = 0.14$ and k_2 0.003, indicating that the number of stable radiation defects is ~7 times less than the theoretical value, which is in agreement with the published data. The low value of k_2 is due to the low concentration of P compared with the concentration of O. (BBB)

26525 MOESSBAUER STUDY OF METAMAGNETIC Eu_3O_4 AND FERROMAGNETIC EuO. Wickman, H. H. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Catalano, E. J. Appl. Phys., 3: 1248-9(Feb. 1, 1968).

The Moessbauer technique has been employed to study the metamagnetic oxide Eu_3O_4 and the ferromagnet EuO. In Eu_3O_4 both di- and trivalent europium ions are present (in the ratio 1:2) with isomer shifts at 77°K of −1.25 ± 0.02 and +0.06 ± 0.02 cm/sec, respectively. In the helium temperature range the divalent ions in Eu_3O_4 showed magnetic hfs, with a hyperfine field of 305 ± 8 kOe at 1.2°K. The temperature dependence of the magnetic hfs of the Eu^{++} nuclei was followed from 1.2°K to the zero magnetic field Néel point of 6.2 ± 0.2°K determined during these measurements. The data are only modestly well approximated by a Brillouin function with $J = 7/2$. No hfs was found at the trivalent side. In EuO, the temperature dependence of the hyperfine field was followed from 77° to 4.2°K. The data are compared with predictions of two models for a cubic ferromagnet. (auth)

26526 DECAY OF THE PROJECTED CHARACTERISTIC LUMINESCENCE OF KI AND KI(In) AFTER EXCITATION BY X-IRRADIATION. Stuehmer, Gerhard; Blume, Hartwig; Brauer, Peter (Univ., Freiburg i. B.). Z. Naturforsch., 22A: 1811-13(Nov. 1967). (In German).

The decay of the V_k luminescence excited in KI(In) crystals by x radiation was studied. The recombination luminescence after x radiation below 100°K can be extinguished with infrared light. The recombination luminescence decays exponentially. The decay time agrees with that in excitation in the ground lattice absorption. The luminescence emitted by x-ray colored KI crystals does not decay exponentially. The appearance of the decay curve of the luminescence and the length of the decay curve are dependent on the excitation state of the crystal. A model is proposed for the experimental results. (J.S.R.)

26527 DISLOCATION EFFECTS ON THE LUMINESCENCE OF CdS CRYSTALS. Mitsuhashi, H.; Komura, H.; Chikawa, J. (Shizuoka Univ., Hamamatsu, Japan). pp 179-89 of II-VI Semiconducting Compounds. Thomas, D. G. (ed.). New York, W. A. Benjamin, Inc., 1967.

From International Conference on II-VI Semiconducting Compounds, Providence. See CONF-670922.

Dislocation effects on the emission spectra of CdS under x-ray excitation at 77°K have been studied. (1) For the study of a high dislocation density, the crystals were bent around an axis in a ⟨1100⟩ direction. Depending on the bending, Cd or S dislocations were introduced selectively after polygonization. The red emission at 6350 and 7400 Å from the crystals with S dislocations was much brighter than from crystals with Cd dislocations. The S dislocations are thought to attract Cd ions at the normal sites, acting as the source of Cd vacancies. These defects form the center responsible for the emission. (2) Bending around the c axis was observed to cause the green edge emission. The dislocations conceivably act as the source of both S and Cd vacancies. Thus the green edge emission may be concluded to be due to vacancy pairs. (3) The effects of spatial variation of dislocations of a low density have been studied with as-grown crystals, consisting of a dislocation-free region with dislocations at a density of 10^4 cm^{-2}. The latter showed a weaker blue edge emission than the former. The x-ray topography showed that straight right-handed screw dislocations climbed into left-handed helix dislocations with large diameters by absorbing interstitial atoms, resulting in a deficiency of interstitial Cd and S. Thus interstitial Cd and/or S atoms are considered to participate in the center responsible for the blue edge emission. (auth)

26528 RECOMBINATION PROCESSES IN CdS UNDER HIGH EXCITATION. Benoit a la Guillaume, C.; Debever, J. M.; Salvan, F. (Paris Univ.). pp 669-81 of II-VI Semiconducting Compounds. Thomas, D. G. (ed.). New York, W. A. Benjamin, Inc., 1967.

From International Conference on II-VI Semiconducting Compounds, Providence. See CONF-670922.

In order to explain the mechanism of laser emission in CdS, the spectral dependence of the spontaneous emission and of the optical gain was measured. These experiments, performed between 4 and 100°K on several types of platelets, as a function of the excitation (electron beam pumping) give the following results: (a) no measurable gain is obtained from the bound excitons, (b) the gain corresponding to the recombination of free excitons with emission of one LO phonon was measured. The density of free excitons can be computed from the gain. Such a process can explain the laser emission in long cavity ($l > 1$ mm). (c) A recombination process involving two excitons is proposed to explain an additional process giving a larger gain. (d) The theoretical calculation of a recombination process involving one exciton and one electron is given. (auth)

26529 HIGH POWER AND EFFICIENCY IN CdS AND CdSe ELECTRON-BEAM-PUMPED LASERS. Hurwitz, C. E. (Massachusetts Inst. of Tech., Lexington). pp 682-93 of II-VI Semiconducting Compounds. Thomas, D. G. (ed.). New York, W. A. Benjamin, Inc., 1967.

From International Conference on II-VI Semiconducting Compounds, Providence. See CONF-670922.

Pulsed electron beam excitation of CdS and CdSe crystals grown in an atmosphere of excess Cd has yielded lasers with more than 300 W of peak output power and greater than 26% overall (35% internal) power conversion efficiency at low temperatures. Emission wavelengths are in the vicinity of 4900 Å in CdS and 6900 Å in CdSe. The high performance of these lasers appears to be due to increased crystal uniformity and to the introduction or enhancement of highly efficient radiative transitions, both of which result from the Cd-rich growth conditions. (auth)

26530 TEMPERATURE DEPENDENCE OF NUCLEAR SPIN-LATTICE RELAXATION IN SINGLE-CRYSTAL CADMIUM SULFIDE. Look, D. C.; Wepfer, G. G. (Wright-Patterson AFB, Ohio). pp 1222-31 of II-VI Semiconducting Compounds. Thomas, D. G. (ed.). New York, W. A. Benjamin, Inc., 1967.

From International Conference on II-VI Semiconducting Compounds, Providence. See CONF-670922.

The ^{113}Cd nuclear magnetic spin-lattice relaxation time, T_1 has been measured as a function of temperature, T = 77 to 450°K, and frequency, ν = 2 to 10 MHz, in a low-resistivity crystal of n-type CdS. The mechanism for the relaxation is attributed to the magnetic dipole–dipole interaction with trapped and low-mobility electrons. (auth)

26531 ON THE PROPERTIES OF SOME DEFECT CENTERS IN CdTe. Urli, N. B. (Inst. Ruder Boskovic, Zagreb). pp 1335-47 of II-VI Semiconducting Compounds. Thomas, D. G. (ed.). New York, W. A. Benjamin, Inc., 1967.

From International Conference on II-VI Semiconducting Compounds, Providence. See CONF-670922.

An investigation of the electronic properties of some defect centers in CdTe was made on semi-insulating crystals, obtained by reactor neutron irradiation. An increase in resistivity of four to five orders of magnitude occurred after thermal neutron bombardment of p-type crystals, and it was somewhat less in the case of fast neutrons. A two-carrier effect, very low mobilities (~0.1 cm^2/V-sec) and negative photoconductivity were revealed in the case of highly compensated samples, as determined by photo-Hall measurements. A possible explanation of such behavior is given. The importance of oxygen chemisorption processes is also discussed. (auth)

26532 PROCEEDINGS OF THE NUCLEAR PHYSICS AND SOLID STATE PHYSICS SYMPOSIUM, KANPUR, FEBRUARY 27–MARCH 3, 1967. SOLID STATE PHYSICS. Trombay, India, Bhabha Atomic Research Centre, 1967. 271p. (CONF-670220-(Vol.1)).

Forty-eight papers are included, treating such subjects as thermal and electrical properties of solids, superconductors, Moessbauer studies, magnetic and spin resonance, magnetism, positrons, neutron scattering, and crystal structure and growth. Separate abstracts were prepared for 12 of the papers. (D.L.C.)

For abstracts of individual papers see: 26205, 26207, 26208, 26322–26325, and 26459–26463.

26533 II-VI SEMICONDUCTING COMPOUNDS. 1967 International Conference held at Providence, Rhode Island, September 6-8, 1967. Thomas, D. G. (ed.). New York, W. A. Benjamin, Inc., 1967. 1503p. $19.75. (CONF-670922).

Some 95 papers and a record of following discussions are presented on the semiconductive, luminescent, piezoelectric, and other aspects of the compounds of the 2nd and 7th groups of the periodic table. Among the topics covered are: optical properties, ESR, thermo- and photoluminescence, band structure, defects, excitons, phonons, reflectance, crystal growth, laser transitions, recombination processes, electric and magnetic properties, and lattice dynamics. Separate abstracts were prepared for 5 papers dealing with luminescence, laser emission, nuclear spin-lattice relaxation, and defects in CdS, CdSe, and CdTe. (D.L.C.)

For abstracts of individual papers see: 26527–26531.

26534 CHEMICAL BONDS IN SEMICONDUCTORS AND SOLIDS. Sirota, N. N. (ed.). New York, Consultants Bureau, 1967. 304p.

Translation of Khimicheskaya Svyaz' v Poluprovodnikakh i Tverdykh Telakh.

Papers are given in the following areas: general questions relating to the chemical bond in semiconducting crystals, experimental determination of electron density and evaluation of the chemical bond in semiconductors, dynamics of the crystal lattice of semiconductors and the chemical bond in crystals, and questions of the chemical bond and the physical properties of semiconductors. (W.D.M.)

26535 RADIATSIONNAYA FIZIKA. V. LYUMINESTSENTSIYA I DEFEKTY IONNYKH KRISTALLOV. (Radiation Physics. Part V. Luminescence and Defects of Ionic Crystals). Riga, Izdatel'stvo Zinatne, 1967. 296p.

Eight review articles are included on radioluminescence of alkali metal halide crystals, radiation defects in these crystals, and thermoluminescence dosimetry. The nature of the defects and mechanism of their formation in charged-particle tracks (α particles and fission fragments) are discussed, as well as the kinetics of formation of color centers in activated alkali metal halide crystals. Data are included on the radioluminescence of activated alkali metal halide phosphors and their dependence on the tem-

perature and flux of excitation radiation. 367 references are given on thermoluminescence dosimetry and extensive references are included at the end of each of the eight articles. (R.V.J.)

Theoretical Physics

Refer also to abstract 26407.

26536 ON THE CAUCHY PROBLEM OF THE RELATIVISTIC BOLTZMANN EQUATION. Bichteler, Klaus (Southwest Center for Advanced Studies, Dallas). Commun. Math. Phys., 4: 352-64 (1967).

A formulation of a theorem is given concerning the Cauchy problem for the relativistic Boltzmann equation. It is shown that the relativistic Boltzmann equation has a local solution in terms of an initial distribution function, if the scattering cross section is bounded for high energies and if the initial distribution decreases exponentially with energy. (IAA)

26537 ON THE RITZ FORMULA AND QUANTUM DEFECTS OF THE SPECTRUM OF THE SCHROEDINGER RADIAL EQUATION. Sakhnovich, L. A. (Odessa Electrotechnical Inst. of Communications). Izv. Akad. Nauk SSSR, Ser. Mat., 30: 1297-1310(1966). (In Russian).

The radial Schroedinger equation is studied, and proof of the correctness of the Ritz formula is demonstrated. For $q(r) = 0$, the equation for the hydrogen atom is obtained, the discrete spectrum of which is given. For the spectra of other atoms, the Rydberg formula and the Ritz formula are used. The number δ_l' denotes a quantum defect of a discrete spectrum. The author also introduces the concept of a quantum defect δ_l' for a continuous spectrum. This quantity is in a certain sense a measure of deviation from the case of the hydrogen atom. The existence of the quantum defects δ_l and δ_l' in discrete and continuous spectra of the Schroedinger equation is proved, and the equality, $\delta_l = \delta_l'$, is demonstrated for a particular class of potentials. (ATD)

26538 ELECTROMAGNETIC FIELDS OF ACCELERATED NONRADIATING CHARGE DISTRIBUTIONS. Arnett, J. B.; Goedecke, G. H. (New Mexico State Univ., University Park). Phys. Rev., 168: 1424-8(Apr. 25, 1968).

Exact expressions for the retarded electromagnetic potentials are derived for certain extended, rigid, accelerated, but nonradiating charge-current distributions. An unexpected result is that the oscillating parts of these potentials vanish identically for all points of space-time which are outside the distributions. Since each of these nonradiating distributions undergoes time-periodic orbital motion, with the "radius" of the orbit less than the radius of the distribution, this result means that the oscillating part of the electromagnetic field energy is localized within a volume of the same order as the volume of the distribution. (auth)

26539 CONSEQUENCES OF MEASUREMENT IN QUANTUM MECHANICS. I. AN IDEALIZED TRAJECTORY DETERMINATION. Scott, William T. (Univ. of Nevada, Reno). Ann. Phys. (N. Y.), 46: 577-92(Feb. 1968).

An idealized thought experiment is presented which illustrates certain features of the theory of measurement in quantum mechanics. Measurements of momentum and time-of-passage of a particle are proposed which provide information on the previous history of the particle insofar as it can be described by an equation of the form $x = x_0 + v_0 t$. Particular features of the measurement process that are illustrated are (a) simultaneous measurements of time and energy, limited in precision by a Heisenberg relation; (b) the selection of a portion of the incoming wave-pocket by magnetic deflection and a slit system; (c) the approach with increasing resolution of any one of the selected portions towards an eigenstate of momentum; and (d) the irrelevance in this case of Von Neumann's projection postulate and the "reduction of the wave packet" phenomenon because the approach to an eigenstate occurs before the measurement is completed. It is assumed that the operation of a detector aperture can be described in terms of a weight function multiplying the wavefunction in momentum space, the absolute square of which gives the detector efficiency function. Successive measurements are not treated in this paper, which follows the usual quantum-mechanical practice of dealing with the unfolding-in-time of states only between a preparation and a single act of measurement. Three kinds of uncertainty principle are distinguished, dealing, respectively, with independent, simultaneous, and successive measurements. (auth)

26540 THREE-PARTICLE HYPER-NETTED CHAIN APPROXIMATION. Baxter, R. J. (Australian National Univ., Canberra). Ann. Phys. (N. Y.), 46: 509-45(Feb. 1968).

The principles on which the two-particle convolution hypernetted chain approximation of classical statistical mechanics is based, namely summation over a specific class of Yvon-Mayer diagrams and use of a variational principle, are used to derive a three-particle approximation. This approximation gives a symmetric three-particle correlation function and is applicable to a system with three-, as well as two-particle interactions. (auth)

26541 MOTION OF A CHARGED PARTICLE IN A TWISTED MAGNETIC FLUX TUBE. Willis, D. M. (Radio and Space Research Station, Slough, Eng.). Planet. Space Sci., 16: 395-408(Apr. 1968).

The motion of a charged particle in a twisted magnetic flux tube, which has constant intensity and helical lines of force, is examined from first principles for the case in which the radius of the flux tube is small compared with the constant pitch length of the helical lines of force. It is assumed that the radial variation in the direction of the magnetic field is small within a gyroradius, but that the apparent temporal variation of the field associated with the axial motion of the particle is not necessarily small within a gyroperiod. These conditions are less restrictive than those required for the validity of the guiding-centre approximation. For trapped orbits the projection of the particle trajectory on a plane perpendicular to the axis of the flux tube is an epitrochoid and the axial motion comprises a small oscillation superimposed on a uniform velocity. If the axial distance travelled by a particle in a gyroperiod is small compared with the pitch length of the helical lines of force, the detailed solution is completely consistent with the guiding-centre approximation. In this case the trajectory of the particle is very nearly a helix wound around a helical line of force. If the axial distance travelled by a particle in a gyroperiod exceeds the pitch length of the helical lines of force, the particle does not describe a trapped orbit and is ejected from the flux tube. In this case the particle motion is very similar to the nonadiabatic type of motion found previously in a study of particle trajectories in a simple force-free magnetic field with constant intensity and straight lines of force. The results are illustrated by considering the motion of charged particles in the model magnetospheric tail proposed by Dessler and Juday. [Dessler, A. J. and Juday, R. D. (1965). Planet Space Sci. 13, 63]. (auth) (UK)

26542 PROCESSING MAGNETIC FIELD DATA. Wind, H. (CERN, Geneva). J. Comput. Phys., 2: 274-8(Feb. 1968).

A method is derived to make a "least squares fit" to measurements of the components of a magnetic field at various points in three dimensions. To do so, a polynomial model of the field is designed such that the equations $\nabla \cdot B = 0$, $\nabla \times B = 0$ are satisfied. This method is obviously equally well applicable to any other field obeying the above equations. (auth)

26543 EXPERIMENTAL TESTS OF QUANTUM MECHANICS. Clark, P. M.; Turner, J. E. (Univ. of Birmingham, Eng.). Phys. Lett., 26A: 447-9(Apr. 8, 1968).

A general principle which distinguishes experimental tests of quantum theory from tests of the corresponding hidden variable theories is discussed. (auth)

26544 N-REPRESENTABILITY PROBLEM FOR AN ODD NUMBER OF FERMIONS. Ruskai, Mary Beth; Harriman, John E. (Univ. of Wisconsin, Madison). Phys. Rev., 169: 101-13(May 5, 1968).

The N-representability problem for the first- and second-order density matrices is considered when N is an odd integer. Attention is restricted to those density matrices derivable from functions whose natural spin orbitals have certain paired properties. Neither pairing of spatial orbitals nor special spin properties are required in general, but they are discussed as special cases. New sufficient conditions for N-representability of the first-order density matrix are given. The second-order density matrix is studied in detail. Special cases in which the N-representability problem for the second-order density matrix can be solved are considered. (auth)

26545 ATOMIC, MOLECULAR, AND SOLID-STATE THEORY. Proceedings of the International Symposium held at Sanibel Island, Florida, January 16-21, 1967. Lowdin, Per-Olov (ed.). International Journal of Quantum Chemistry, Symposium No. 1. New York, Interscience Publishers, 1967. 871p. (CONF-670121).

The proceedings of the symposium contain essentially the invited and contributed papers at the meeting which present new results. Only such discussion remarks as were presented in writing are included. Some of the papers that were presented in condensed form because of lack of time are reproduced in full length. A few specially invited written contributions to the symposium are also included. (W.D.M.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Electromagnetic

Refer also to abstract 26557.

26546 (DESY-F-32/4) DIE PHOTOPRODUKTION VON ρ^0-MESONEN MIT γ-QUANTEN BEKANNTER ENERGIE. (The Photoproduction of Mesons (ρ^0) with γ Quanta of Known Energy). Blechschmidt, Horst (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Feb. 1968. 72p. (In German). Dep.

In a spark chamber experiment pion pairs produced by energy-tagged photons on hydrogen, carbon and aluminum were measured. For ρ^0-production, the differential cross section $d\sigma/dt$ exhibits an exponential behavior like $(d\sigma/dt)_{t=0} \cdot e^{at}$ with a $\sim A^{1.68 \pm 0.1}$ and $(d\sigma/dt)_{t=0} \sim A^{\frac{4}{3}}$. The differential cross section for ρ^0-photoproduction in the forward direction $(d\sigma/d\Omega)_{\theta=0}$ was found to be proportional to the square κ^2 of the energy of the incoming photon. The resulting total cross sections are $\sigma_{tot} = 14.6 \pm 1.8$ μb for H_2, $\sigma_{tot} = 130 \pm 22$ μb/nucleus for C and $\sigma_{tot} = 284 \pm 40$ μb/nucleus for Al. On the basis of the photon dissociation model, the best fits for mass and width of the ρ^0-meson are $m_\rho = 764$ MeV, $\Gamma_\rho = 124$ MeV for H_2; $m_\rho = 777$ MeV, $\Gamma_\rho = 126$ MeV for C; $m_\rho = 770$ MeV, $\Gamma_\rho = 117$ MeV for Al, with $\Delta m_\rho = \pm 12$ MeV and $\Delta\Gamma_\rho = \pm 15$ MeV. (auth)

26547 (SLAC-PUB-330) ELECTRON TRIDENT AND PAIR PRODUCTION AT 500 MeV. Grossetete, B.; Tchapoutian, R. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire); Drickey, D. J.; Yount, D. (Stanford Linear Accelerator Center, Calif.). Dec. 1967. 69p. (LAL-1177). Dep. CFSTI.

The cross sections, differential in the recoil positron energy, for trident and quartet production and for bremsstrahlung followed by pair and triplet production were measured for beryllium, aluminum, and platinum targets at a nominal incident electron energy of $E_0 = 500$ MeV and for recoil positron energies in the range above $0.80\ E_0$. The estimated experimental errors are about ±6% for the direct process and about ±3% for the double process at most points. The (pair + triplet) data for all three elements are in excellent agreement with theoretical predictions which contain detailed screening calculations and which take into account electron–electron bremsstrahlung and pair production in the electron field. A satisfactory fit (χ^2 probability 0.22) to the (trident + quartet) data was obtained with the no-screening calculations of Murota, Ueda, and Tanaka when the integration parameter (α in their notation) had a value (0.75 ± 0.05) and when quartets were taken into account by the substitution $Z^2 \rightarrow Z(Z + \eta)$, where η is the ratio of the total cross sections for electron–electron and electron–nucleon bremsstrahlung. If the time-like photon contributions, which amount to roughly 35% of the net cross section, are left out, the integration parameter has an optimum value of (2.00 ± 0.20). The corresponding χ^2 probability is much less than 0.01, indicating the necessity of the time-like terms. (auth)

26548 MEASUREMENT OF THE K^0–K^+ MASS DIFFERENCE. Hill, D. G. (Brookhaven National Lab., Upton, N. Y.); Robinson, D. K.; Sakitt, M.; (and others). Phys. Rev., 168: 1534-6(Apr. 25, 1968). (BNL-12003).

Using the charge-exchange reaction $K^+ + d \rightarrow p + p + K^0$, the K^0-K^+ mass difference was measured and $M_{K^0} - M_{K^+} = 3.95 \pm 0.21$ MeV was obtained. Combining this result with previous measurements of both K^0-K^+ and $\bar{K}^0$-K^- mass differences, one finds $M_{K^+} - M_{K^-} = 0.02 \pm 0.24$ MeV. (auth)

26549 POLARIZATION OF RECOIL PROTONS FROM NEUTRAL PION PHOTOPRODUCTION. Lundquist, D. E.; Anderson, R. L.; Allaby, J. V.; Ritson, D. M. (Stanford Univ., Calif.). Phys. Rev., 168: 1527-33(Apr. 25, 1968).

The polarization of recoiling protons from the photoproduction of π^0 mesons on liquid hydrogen was measured for primary photon energies between 500 and 1000 MeV over a range of π^0 c.m. angles from 55° to 130°. The results show structure not observed previously in experiments of less precision. In particular, the polarization at 90° c.m. is close to zero at a primary photon energy of 900 MeV. Also, a strong dependence of polarization on π^0 c.m. angle between 600 and 900 MeV was observed. A subsidiary measurement of the polarization of the recoil proton from elastic e-p scattering at 900 MeV and $q^2 = 10$ F^{-2} gave a value (1.3 ± 2.0)%. (auth)

26550 A MEASUREMENT OF LONGITUDINAL PHOTON CONTRIBUTION IN PION ELECTROPRODUCTION FROM PROTONS. Betourne, C.; Feautrier, C.; Perez-y-Jorba, J.; Treille, D. (Ecole Normale Superieure, Orsay, France). Nucl. Phys., B5: 355-68(1968).

A measurement of the pion electroproduction cross section from protons, at a transfer $q^2 = -3.4$ fm^{-2} and a πN mass of 1136 MeV, gave the values $\sigma_L = 27.0 \pm 9.2$ μb, $\sigma_T = 81.8 \pm 4.3$ μb, $\sigma_L/\sigma_T = 0.33 \pm 0.13$. It is shown that this result is very sensitive to a correct application of radiative corrections but rather insensitive to the exact analytic expression used. (auth)

26551 PHOTOPRODUCTION OF φ MESONS FROM CARBON AT 1800 MeV. Mostek, P.; Eisenhandler, E.; McClellan, G.; Mistry, N.; Ogren, H.; Silverman, A.; Swartz, J.; Talman, R. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 20: 1057-9 (May 6, 1968).

The cross section for photoproduction of φ mesons at 0° was measured by 1800-MeV photons. Approximately 165 φ's were observed, yielding a cross section $d\sigma/dt = (0.75 \pm 0.17)\mu b/GeV^2$/nucleon for $|t| = 0.175$ GeV^2. This value is consistent with a "vector-dominance" prediction using ρ^0 photoproduction data, SU(3) coupling constants, and a quark-model prediction for the ρ- and φ-nucleon cross sections. (auth)

26552 DIFFERENTIAL CROSS SECTIONS FOR NEUTRAL-PION ELECTROPRODUCTION NEAR THE FIRST PION–NUCLEON RESONANCE. Mistretta, C.; Imrie, D.; Appel, J. A.; (and others) (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 20: 1070-3(May 6, 1968).

Electron-proton coincidences from the reaction $e^- + p \rightarrow e^- + p + \pi^0$ were measured for pion-nucleon center-of-mass energies in the region of the $N^*(1236)$ resonance at four-momentum transfers near 1, 3, 6, and 10 F^{-2} [0.05 to 0.4 (BeV/c)^2]. Data have been obtained for pion polar angles between 100° and 180° c.m. over a wide range of azimuthal angles. The results are compared with the dispersion theories of Adler and Zagury. (auth)

26553 EXPERIMENTAL LIMITS ON THE EXISTENCE OF ANOMALOUS ELECTRONS. Fischbach, E.; Kirsten, T.; Schaeffer, O. A. (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 20: 1012-14(Apr. 29, 1968).

Experimental and theoretical evidence is presented against the existence of particles which differ from electrons by a conserved internal quantum number. (auth)

26554 QUASIELASTIC ELECTRON–DEUTERON SCATTERING BETWEEN $q^2 = 18$ fm^{-2} AND 100 fm^{-2}. Albrecht, W.; Behrend, H.-J.; Dorner, H.; Flauger, W.; Hultschig, H. (Deutsches Elektronen-Synchrotron, Hamburg). Phys. Lett., 26B: 642-4(Apr. 15, 1968).

Quasielastic e-d scattering measurements were performed up to $q^2 = 100$ fm^{-2}. Only the electron was detected. The ratio $R = (d^3\sigma/d\Omega dE')_{ed}/(d\sigma/d\Omega)_{ep}$ was measured at the quasielastic peak; the magnetic form factor G_M^N of the neutron was deduced using the assumption $G_E^N = 0$. (auth)

26555 MEASUREMENT OF THE POLARIZATION OF THE RECOIL NEUTRON FROM THE PHOTOPRODUCTION OF CHARGED PIONS ON HYDROGEN. Althoff, K. H.; Piel, H.; Wallraff, W.; Wessels, G. (Univ., Bonn). Phys. Lett., 26B: 640-1(Apr. 15, 1968).

The polarization of the recoil neutron in the reaction $\gamma + p \rightarrow \pi^+ + n$ was measured for a pion c.m.-angle of 90° and a photon energy of 390 MeV. Hydrogen was used as the polarization analyzer. (auth)

Weak

Refer also to abstract 27383.

26556 $K_1^0 \rightarrow K_2^0$ MASS DIFFERENCE. Balatz, M. Ya.; Berezin, V. M.; Vishnevskyii, M. E.; (and others) (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett., 26B: 320-2(Feb. 5, 1968).

The mass difference between K_1^0 and K_2^0 mesons was determined. K_1^0-mesons were produced as a result of coherent regeneration in Al plates placed in a K^0-beam. The intensity of $K^0 \rightarrow \pi^\pm$ decay was measured at different thicknesses of the regenerator. $K^0 \rightarrow \pi^\pm$ decays were detected by a magnet spectrometer with

spark chambers. The obtained value of the mass difference is $\delta = 0.53^{+0.9}_{-1.1}$ [$\hbar/r_1c^2$]. (auth)

Strong (Baryon-Induced)

Refer also to abstract 26805, 26806, 26809, 26810, 27280, and 27288.

26557 QUASIFREE NUCLEON–NUCLEON BREMSSTRAHLUNG AT 197 MeV. Koehler, P. F. M.; Rothe, K. W.; Thorndike, E. H. (Univ. of Rochester, N. Y.). Phys. Rev., 168: 1536-49(Apr. 25, 1968).

Quasifree nucleon-nucleon bremsstrahlung processes were studied at 197 MeV by bombarding a target of liquid deuterium with a 90% polarized proton beam. A γ detector gave the directions of photons of energy $E_\gamma \geq 40$ MeV; spark chambers triggered by large-area counters were used to determine the direction(s) and range(s) of the energetic charged particle(s) which emerged in coincidence with a γ ray. Samples of events from three final states were extracted: (1) $p + d \rightarrow n_s + p + p + \gamma$; (2) $p + d \rightarrow p_s + d + \gamma$; (3) $p + d \rightarrow P + d + \gamma$. Events of type (1) exhibited angular distributions and a γ spectrum in agreement with free ppγ results, while the cross sections were reduced by a factor of 0.50 ± 0.10. Differential cross sections for reaction (2) were found to be reduced by a factor of 0.75 ± 0.15 from the values predicted for the free capture reaction; the γ-ray asymmetries were in good agreement with predictions from deuteron photodisintegration; the branching ratio for the production of the n-p system in the slightly unbound final state to that in the bound $^3S_1$ final state was found to be 0.22 ± 0.04. The cross section for reaction (3) was small, and its study was strongly limited by the detection thresholds of the spark chambers. Events from the reaction $p + d \rightarrow p_s + n + p + \gamma$ could not be identified with our apparatus, but they were the only other contributors to the coincidence rates between a γ ray and a single charged particle. By subtracting the measured contributions from reactions (1)–(3) from them, we obtained differential cross sections for quasifree n-p bremsstrahlung at three angles. Cross sections for free npγ were deduced from them and $\sigma_{np\gamma} = 35 \pm 12$ μb was found. This result implies a ratio $\sigma_{np\gamma}/\sigma_{pp\gamma} \cong 50 \pm 20$. (auth)

26558 PRODUCTION OF K^+ MESONS IN 2.85- AND 2.40-BeV p–p COLLISIONS. Reed, J. T. (Univ. of Rochester, N. Y.); Melissinos, A. C.; Reay, N. W.; Yamanouchi, T.; Sacharidis, E. J.; Lindenbaum, S. J.; Ozaki, S.; Yuan, L. C. L. Contract AT-875-UR. Phys. Rev., 168: 1495-1508(Apr. 25, 1968). (UR-875-228).

An experimental measurement is reported of K^+-meson production in p-p collisions at 2.85 and 2.40 BeV. The momentum spectra of the K^+ mesons are given at the three laboratory angles of 0, 17, and 32°. The K^+ mesons were identified by momentum and velocity using differential Čerenkov counters with a combined rejection of the order of 10^{-6}. It is shown that the production spectra can be accounted for by a one-meson-exchange mechanism with the introduction of appropriate cutoffs. At the high-energy limit of the 0° spectrum, a clear peak is observed, which is attributed to the low-energy Λ-p interaction in the KAp final state. No other enhancements or pronounced effects due to resonances either in the Yp or KY system are observed. (auth)

26559 ON THE NEUTRONS PRODUCED IN 24 GeV PROTON INTERACTIONS IN GRAPHITE. Aditya, P. K.; Jha, S. K.; Lokanathan, S.; Bhalla, K. B. (Indian Inst. of Tech., New Delhi). Nucl. Phys., B5: 250-4(1968).

The energy of neutral particles originating in 24 GeV/c proton interactions in carbon was investigated from the interactions produced by them in an emulsion stack exposed behind a graphite target placed in the 24 GeV/c proton beam at CERN. The energy was estimated from the cases $n_s \geq 2$, 3, and 4. It is found that the high-energy neutrons which survive the interactions have about one third of the primary energy. (auth)

26560 STUDY OF THE STRUCTURE IN THE ANTIPROTON–PROTON TOTAL CROSS SECTION NEAR 1.3 GeV/c. Cooper, W. A.; Hyman, L. G.; Manner, W.; Musgrave, B.; Voyvodic, L. (Argonne National Lab., Ill.). Phys. Rev. Lett., 20: 1059-62 (May 6, 1968).

The $\bar{p}p$ interaction was investigated at eight incident beam momenta between 1.2 and 1.6 GeV/c. Several possible explanations are given for the bump appearing in the total cross section at 1.32 GeV/c. It is concluded that no smooth excitation function for single-pion production can be found which is consistent with the data and reproduces the bump in σ_{tot}. (L.B.S.)

26561 SIGMA PRODUCTION IN p–p COLLISIONS AT 5 GeV/c. Sondhi, I. (Princeton Pennsylvania Accelerator, N. J.). Phys. Lett., 26B: 645-8(Apr. 15, 1968).

The cross section for the reaction $pp \rightarrow \Sigma^+K^+n$ at 5 GeV/c is measured to be 48.1 ± 3.5 μb. The KΣ mass spectrum shows an enhancement at 1.86 GeV, which may be due to the $\Delta(1920)$ resonance. Adequacy of the one-pion exchange model for the reaction is discussed. The cross section for the reaction $pp \rightarrow \Sigma^+K^0p$ is found to be 24.9 ± 2.3 μb. (auth)

26562 FINAL STATE $pd\pi^+\pi^-$ IN pd INTERACTIONS AT ABOUT 2 GeV/c. Brunt, D. C.; Clayton, M. J.; Westwood, B. A. (Cambridge Univ., Eng.). Phys. Lett., 26B: 317-19(Feb. 5, 1968).

Results are presented on 265 examples of the final state $pd\pi^+\pi^-$. It is shown that a large number of the events involve baryon exchange. Evidence is also presented for a $d\pi$ resonance of mass 2130 MeV and width 50 MeV. (auth)

26563 SPIN AND PARITY OF THE A_3^+ PRODUCED IN $\bar{p}p$ ANNIHILATIONS. Donald, R. A. (Liverpool Univ.); Edwards, D. N.; Moore, R. S.; (and others). Phys. Lett., 26B: 327-30 (Feb. 5, 1968).

Evidence supporting the assignment $J^P = 2^+$ for the A_3 meson is obtained from analysis of $\bar{p}p \rightarrow \pi\pi\pi\pi$ with 1.2 GeV/c antiprotons. (auth)

Strong (Meson-Induced)

Refer also to abstract 26651.

26564 (UCRL-18131) SINGLE PION PRODUCTION IN THE K^+p CHANNEL FROM 860 TO 1360 MeV/c. Bland, Roger Woodard (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 11, 1968. Contract W-7405-eng-48. 156p. Dep. CFSTI. Thesis.

A study was made of single pion production by K^+ mesons on protons from 860 to 1360 MeV/c incident beam momentum. Strong $N^*(1236)$ production was found in this region, with its maximum cross section occurring slightly below the 1250 MeV/c peak in the total cross section reported by Cool et al. A partial wave analysis of the KN^* final state indicates that the N^* production is dominated by the $P_{\frac{3}{3}}$ and $P_{\frac{1}{3}}$ states in the region of the Cool peak, with no evident phase variation from 860 to 1360 MeV/c. The N^* production is qualitatively consistent with the predictions of the magnetic dipole (M1) ρ-exchange model; near threshold, however, the experimental cross section is too high by a factor of 5 and the detailed partial wave structure deviates considerably from the M1 predictions. The smooth variation with beam momentum of all properties of the K^+p system suggests that the K^+p channel has no strong resonant activity, and should be interpreted in terms of t-channel phenomena. (auth)

26565 (UCRL-18141) ETA PRODUCTION IN THE REACTION $\pi p \rightarrow \pi p\eta$ AT 1170 AND 1050 MeV/c. Grossman, Ronald Allen (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 4, 1968. Contract W-7405-eng-48. 88p. Dep. CFSTI. Thesis.

Eta production was investigated in the reaction $\pi^+p \rightarrow \pi^+p\eta$ at 1050 and 1170 MeV/c, and in the reaction $\pi^-p \rightarrow \pi^-p\eta$ at 1170 MeV/c. The following partial cross sections were obtained for the reaction $\pi^+p \rightarrow \pi^+p\eta$ followed by the charged decay $\eta \rightarrow \pi^+\pi^-\pi^0$: (9.5 ± 1.5) μb for 1050 MeV/c incident π^+; (53.3 ± 5.0) μb for 1170 MeV/c π^+; (15.9 ± 1.9) μb for 1170 MeV/c π^-. From the π^+ data it is found that four $I = 3/2$ amplitudes are needed in order to obtain good agreement with the mass and angular distributions and to reproduce the threshold behavior of the cross section. The dominating amplitude is found to be that representing the reaction, $\pi^+p \rightarrow \eta\Delta(1238)$; $\Delta(1238) \rightarrow \pi^+p$, where the η and the $\Delta(1238)$ are produced in s-wave. The four amplitudes are extrapolated to higher energies where the predicted mass and angular distributions and cross sections are compared with the available data. From the π^- data it is found that in addition to the four $I = 3/2$ amplitudes (determined from the π^+ data), one $I = 1/2$ amplitude is required: the amplitude in which all particles are in relative S-states. It is found that this $I = 1/2$ amplitude in fact dominates the π^- reaction. No evidence is seen for production of the $N^*(1550) \rightarrow \eta p$ resonance. (auth)

26566 DIFFERENTIAL PION CHARGE-EXCHANGE SCATTERING AND η PRODUCTION: $\pi^- + p \rightarrow \pi^0 + n$ FROM 2.4 TO 3.8 GeV/c, AT 6 GeV/c, AND AT 10 GeV/c; $\pi^- + p \rightarrow \eta^0 + n$ AT 10 GeV/c. Wahlig, M. A. (Massachusetts Inst. of Tech.; Cambridge); Manelli, I. Contract AT(30-1)-2098. Phys. Rev., 168: 1515-26(Apr. 25, 1968). (MIT-2098-412).

Small-angle differential cross sections are presented for $\pi^- + p \rightarrow \pi^0 + n$ charge-exchange scattering between 2.4 and 3.8 GeV/c. The differential cross section near $t = 0$ displays two minima and one maximum in this momentum interval, reflecting the presence of the $N^*_{\frac{1}{3}}(2420)$, $N^*_{\frac{3}{3}}(2850)$, and $N^*_{\frac{1}{3}}(2650)$ resonances; at larger t values, the cross sections fall off exponentially as a function of t, just as has been previously observed for charge-exchange scatter-

ing above 6 GeV/c. The pion–charge-exchange data reported here at 6 and 10 GeV/c extend out to large angles, showing a maximum near t = 0, followed by an exponential falloff as e^{10t}, a minimum near $-t = 0.6$ (GeV/c)^2, and then a second maximum near $-t = 1.0$ (GeV/c)^2. The $\pi^- + p \rightarrow \eta^0 + n$ differential cross section shows a maximum near t = 0, followed by an exponential falloff as e^{4t}, much less steep than the π^0 slope. These data are compared to our previously published data and to those of the Saclay-Orsay group. (auth)

26567 KAON–NUCLEON TOTAL CROSS SECTIONS FROM 0.6 TO 2.65 GeV/c. Bugg, D. V. (Rutherford Lab., Chilton, Eng.); Gilmore, R. S.; Knight, K. M.; (and others). Phys. Rev., 168: 1466-75(Apr. 25, 1968).

Total cross sections of K^+ and K^- mesons on protons and deuterons were measured in a transmission experiment over the range of laboratory momentum 0.6–2.65 GeV/c: Measurements were made on K^- at 58 momenta at intervals of 25–50 MeV/c; the experimental accuracy is better than 1% above 700 MeV/c, and the momentum resolution of the beam is ±0.6%. Structure is observed in the total cross sections suggesting or confirming Y_1^* resonances at masses of 1665, 1768, 1905, 2020, 2250, and 2455 MeV/c^2 and Y_0^* resonances at masses of 1695, 1819, 1870, 2100, and 2340 MeV/c^2. The K^+ measurements are less extensive, and are concentrated in the momentum range below 1.5 GeV/c; the experimental errors are typically ±0.2 mb. Structure previously reported in the K^+p and K^+d total cross sections near a laboratory momentum of 1.2 GeV/c is confirmed. Total cross sections of K^+ and K^- on carbon were measured at a number of momenta with an accuracy of about ±2%. (auth)

26568 PION–NUCLEON TOTAL CROSS SECTIONS FROM 0.5 TO 2.65 GeV/c. Carter, A. A. (Cambridge Univ., Eng.); Riley, K. F.; Tapper, R. J.; (and others). Phys. Rev., 168: 1457-65(Apr. 25, 1968).

Total cross sections of π^+ and π^- mesons on protons and deuterons were measured in a transmission experiment to relative accuracies of ±0.2% over the laboratory momentum range 0.46–2.67 GeV/c. The systematic error is estimated to be about ±0.5% over most of the range, increasing to about ±2% near both ends. Data were obtained at momentum intervals of 25–50 MeV/c with a momentum resolution of ±0.6%. No new structure is observed in the $\pi^\pm p$ total cross sections, but results differ in several details from previous experiments. From 1–2 GeV/c, where systematic errors are the smallest, the total cross section of π^- mesons on deuterons is found to be consistently higher than that of π^+ mesons by (1.3 ± 0.3)%; about half of this difference may be understood in terms of Coulomb-barrier effects. The πd and πN total cross sections are used to check the validity of the Glauber theory. Substantial disagreements (up to 2 mb) are observed, and the conclusion is drawn that the Glauber theory is inadequate in this momentum range. (auth)

26569 PRODUCTION OF Ω^- HYPERONS IN K^-p INTERACTIONS AT 5.5 GeV/c. Schultz, P. F. (Univ. of Illinois, Urbana); Ascoli, G.; Goldwasser, E. L.; (and others). Phys. Rev., 168: 1509-15(Apr. 25, 1968). (COO-1195-106).

The results of a search for Ω^- hyperon production and decay in K^-p interactions at 5.5-GeV/c K^- momentum are presented. Three unambiguous examples of Ω^- production were found, and the mass of the Ω^- was measured. The mass value obtained is 1671.8 ± 0.9 MeV/c^2. Other details of the three events are given. (auth)

26570 DIRECT PRODUCTION OF ELECTRON-POSITRON PAIRS BY 16.2-GeV/c NEGATIVE PIONS. Kinzer, Robert L.; Burwell, James R. (Univ. of Oklahoma, Norman). Phys. Rev. Lett., 20: 1050-2(May 6, 1968).

Cross sections were measured for direct production of electron-positron pairs by 16.2 BeV/c negative pions in nuclear emulsions. The results show a large discrepancy between experiment and theory. (L.B.S.)

26571 $\rho\pi$ RESONANCES IN $\pi^+\pi^-\pi^0$ SYSTEM. Armenise, N. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy); Ghidini, B.; Picciarelli, V.; (and others). Phys. Lett., 26B: 236-40(Feb. 5, 1968).

Results on the analysis of a neutral $\rho\pi$ system from $\pi^+ + d$ interactions at 5.1 GeV/c are presented. Evidence for a new isoscalar resonance $\rho\pi$ is reported. Its mass, width, and cross section are M = 1.636 GeV, Γ = 0.112 GeV, and σ = 53 μb, respectively. There is no evidence for H and A_1^* resonance production. (auth)

26572 EXPERIMENTAL TEST OF THE ANALOGY BETWEEN MUON AND RADIATIVE PION CAPTURE. Deutsch, J. P.; Grenacs, L.; Igo-Kemenes, P.; Lipnik, P.; Macq, P. C. (Univ., Louvain, Belg.). Phys. Lett., 26B: 315-16(Feb. 5, 1968).

Rate-measurements are reported on muon capture and radiative pion capture reactions in ^{6}Li yielding the ground state of ^{6}He. (auth)

26573 PRECISION MEASUREMENT OF THE Ω^- AND Ξ^0 MASSES. Palmer, R. B. (Brookhaven National Lab., Upton, N. Y.); Radojicic, D.; Rau, R. R.; Richardson, C.; Samios, N. P.; Skillicorn, I. O.; Leitner, J. Phys. Lett., 26B: 323-6 (Feb. 5, 1968). (BNL–11925).

The mass of the Ω^- hyperon was measured to be 1673.3 ± 1.0 MeV. The error includes the statistical as well as a detailed evaluation of the systematic uncertainties. A test was made of the equal mass spacing rule for the SU(3) baryon decuplet and found to be satisfied for a spacing of 141.5 ± 2.5 MeV. (auth)

Particle Interactions and Properties (Theoretical)

General

26574 (JINR–P2-3590, pp 46-51) EFFEKT MESSBAUERA I TEORIYA KVANTOVANNOGO PROSTRANSTVA–VREMENI. (The Moessbauer Effect and the Theory of Quantized Space–Time). Kirzhnits, D. A.; Chechin, V. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). (In Russian).

26575 (JINR–P2-3590, pp 92-4) NELOKALIZOVANNOST CHASTITS KAK PROYAVLENIE SPINA. (Nonlocalizability of Particles as the Spin Effect). Usik, P. A. (Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Yadernoi Fiziki). (In Russian).

26576 (JINR–P2-3590, pp 170-82) O NE S-MATRICHNYKH EKSPERIMENTAKH. (Non S-Matrix Experiments). Shirokov, Yu. M.; Rozanov, N. A.; Kharakhan, M. L. (Akademiya Nauk SSSR, Moscow. Matematicheskii Institut). (In Russian).

26577 (JINR–P2-3590, pp 194-7) O STATISTICHESKOM MEKHANIZME FORMIROVANIYA PSEVDOEVKLIDOVOI METRIKI. (Statistical Mechanism of Formation of the Pseudo-Euclidean Metrics). Prokhorov, L. V.; Franke, V. A. (Leningrad State Univ. (USSR)). (In Russian).

26578 (JINR–P2-3763) INTERFERENTSIYA NETOZHDESTVENNYKH CHASTITS. (Interference of the Nonidentical Particles). Lyuboshits, V. L.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1968. 31p. (In Russian). Dep.

Interference phenomena, appearing by the nonidentical particle registering, were considered. Some aspects of the transition to the limit from the nonidentical particles to the identical ones are discussed. (auth)

26579 (KFKI–4/1968) FAMILIES OF REGGE TRAJECTORIES AT NONVANISHING ENERGY. II. Domokos, G.; Suranyi, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). [1968]. 20p. Dep.

A bound state formalism for a broken trajectory generating algebra is developed. At nonzero energy the "wave function" of a Regge-state is represented as a reducible representation of the zero energy trajectory generating algebra. Perturbation formulas in the total energy for families of Regge trajectories and residues are obtained, their algebraic structure is analyzed. A family of trajectories is phenomenologically parametrized in the Chew–Frantschi approximation by three of four parameters. (auth)

26580 (NP–17395) THEORY OF ELEMENTARY PARTICLE STRUCTURES AND HIGH ENERGY REACTIONS. Namiki, Mikio (Waseda Univ., Tokyo (Japan). Dept. of Physics). June 1966. 270p. Dep.

A study of elementary particle structures and high-energy reactions is made using some simple working hypotheses. Extensive use is made of the assumption of nonrelativistic inner motion for low-lying hadron structures. The inner structure of elementary particles and quasi-static phenomena, high-energy particle reactions, and superhigh energy phenomena are discussed. (J.F.P.)

26581 (ORNL–tr–1921) MANY-PARTICLE INTERACTIONS IN THE HIGH AND ULTRAHIGH ENERGY REGIONS. Artykov, I. Z.; Barashenkov, V. S.; Eliseev, S. M. Translated for Oak Ridge National Lab., Tenn., from report JINR–P2-3508. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The possibility of studying elastic and inelastic processes containing three or more primary particles is pointed out. Conclusions are made pertaining to the character of many-particle interactions, averaged over the number and type of colliding

particles. Non-normalized energy and angular distributions are presented for inelastic many-particle interactions for several energy values. (L.B.S.)

26582 DIVERGENCE CONDITIONS AND EQUAL-TIME COMMUTATORS. Orzalesi, Claudio A. (Univ. of Maryland, College Park). Phys. Rev., 168: 1580-6(Apr. 25, 1968).

The formalism of divergence conditions is studied in an attempt to clarify the basic assumptions involved and the implications for the current-current equal-time commutators. Some general relations among Schwinger and seagull terms are derived. From these it is proved that the usual zero-energy theorems of current algebra can be derived under weak additional assumptions, which still leave the Schwinger terms almost unspecified. Other additional assumptions are briefly considered. Finally, the use of truncated amplitudes is discussed in connection with the cancellation of Schwinger and seagull terms. (auth)

26583 FLUCTUATION-DISSIPATION THEOREM AND QUASIPARTICLE APPROXIMATION. Wohlrab, K.-S. (Institut fuer Spezielle Probleme der Theoretischen Physik, Berlin). Nucl. Phys., B5: 340-4(1968).

Using the fact that the quasiparticle approximation is an averaging approximation, the deviations from it are treated as fluctuations. From this a fluctuation-dissipation theorem is derived which can be used to compare the accuracy of the quasiparticle approximation for superconductors, nuclei, and elementary particles. The theorem shows that the argument "the higher the energies, the worse the quasiparticle approximation" has to be questioned. (auth)

26584 CURRENT-ALGEBRA SUM RULES FOR ARBITRARY SPIN AND MASS. Dosch, H. G. (Massachusetts Inst. of Tech., Cambridge); Gordon, David. Contract AT(30-1)-2098. Phys. Rev., 168: 1817-21(Apr. 25, 1968). (MIT-2098-397).

Fubini-Dashen-Gell-Mann sum rules are derived for targets of arbitrary spin and mass, and implications concerning j-plane analyticity are pointed out. (auth)

26585 ON A RELATIVISTICALLY INVARIANT MASS OPERATOR. Fushchich, V. I. (Inst. of Mathematics, Kiev). Ukr. Fiz. Zh., 13: 363-72(Mar. 1968). (In Russian).

The nontrivial example of the infinite dimensional Lie algebra is constructed, the Poincaré algebra being its subalgebra. The continual Lie algebras U (k,k'), Sp (k,k') are constructed which are the continual analogs of the classic algebras U (N), Sp (2N). The problem on embedding of the Poincaré algebra is formulated in terms of the wave function. A geometrical interpretation of the mass formulas is presented. (auth)

26586 INDEFINITE METRICS AND THE PERTURBATION THEORY. II. Naumov, A. I. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 11, 7-14(1967). (In Russian).

The concepts presented previously on the applicability of the Feynmann techniques to the nonlinear spinor theory of elementary particles were made more precise and amplified. An analysis was made of the possibility of the probable interpretation in the scheme with indefinite metrics and of the construction of unitary physical scattering metrics. The modified perturbation theory was used for the calculation of the meson mass and their coupling constant with nucleons. The results were physically satisfactory. (tr-auth)

26587 JOINT DESCRIPTION OF THE ISOTOPIC AND SPACE-TIME PROPERTIES OF ELEMENTARY PARTICLES. Ivanenko, D. D.; Frolov, B. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., 22: 106-8(1967). (In Russian).

Following up Friedman's theorem on a pseudo-Euclidean space surrounding a pseudo-Riemann space, the O(1,9) group was considered as the symmetry group of elementary particles. In this theory, the O(9) group is analogous with the SU(6) group, being the smallest physically permissible group containing as its subgroup the direct derivative of SU(3) × O(3). The O(1,9) group is analogous with the O(1,3) Lorentz group. In order to introduce into the present theory the Poincare group (the nonhomogeneous Lorentz group), the adjoining S(1,4) de Sitter space must be brought in, together with Minkowsky's tangential space. The theory may be considered a generalization of the classical tetrade formalism of the general theory of relativity; it represents a modification of the theory on the fusion of the usual and isotopic spaces corresponding to the group approach, resulting in an extension of the Lorentz Pauli theorem. (TTT)

26588 SOME GENERALIZATIONS OF THE KLEIN-GORDON WAVE EQUATION AND THEIR TRANSFORMATIONS BY THE CONFORM GROUP. Baktavatsalou, M. (Faculte des Sciences, Abidjan, France). Compt. Rend., Ser. A and B, 266: 178-81 (Jan. 15, 1968). (In French).

The problem of conform invariance of wave equations in Minkowski space is re-examined with the introduction of a generalized mass term, establishing, by conform transformations, a covariant form of a generalized Klein-Gordon wave equation. Also certain particular cases of this equation are considered. (J.F.P.)

26589 MULTIPLE POMERANCHUK EXCHANGE VIOLATES UNITARITY. Finkelstein, J.; Kajantie, K. (CERN, Geneva). Phys. Lett., 26B: 305-7(Feb. 5, 1968).

It is shown that in the multi-Regge model repeated exchange of the Pomeranchuk trajectory would lead to a violation of the Froissart bound, even if the Pomeranchuk has finite slope. It can be shown that an expression for the total cross section considered previously is in fact bounded at least by some power of the energy. Using this fact it is proven that if one considers only those trajectories with intercepts less than one, one need never violate the Froissart bound. (J.F.P.)

Electromagnetic

Refer also to abstracts 25673, 26538, 26664, and 26715.

26590 (IC-68/28) ROLE OF STRONG INTERACTIONS AND THE INTERMEDIATE BOSON IN THE RADIATIVE CORRECTIONS TO WEAK PROCESSES. Sirlin, A. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 1968. 32p. Dep.

Two methods for the problem of radiative corrections to weak interactions are discussed. In the first approach the validity of current algebra at small distances is assumed. Within this context two models are discussed: it is assumed for one model that there is a special form for the space-space part of current algebra, and for the other model the existence of the intermediate boson is assumed. Using the other approach current algebra is not assumed, and an attempt is made to show some general properties of the second-order corrections which are apparently independent of the details of the strong interactions and the possible existence of the intermediate boson. This approach consists essentially in separating out in a finite and gauge invariant manner the contribution of the order 1/K, where K is the photon four momentum as it approaches zero in the hadronic covariants. (J.F.P.)

26591 (JINR-P2-3590, pp 81-5) FRAME-DEPENDENCE OF CROSS SECTIONS. Ingraham, R. L. (International Centre for Theoretical Physics, Trieste (Italy)).

It is urged that a crucial experiment be done in order to test the assumption that scattered particle number is an absolute, regardless of how it is measured. It is shown that this experiment should be very conclusive at high enough laboratory energies and momentum transfers. The cross sections and frame-dependent ratio of the form factors for center-of-mass and laboratory systems are calculated for $e + e$ and $e^+ + e^-$ elastic scattering. (J.F.P.)

26592 (JINR-P2-3774) ASIMMETRIYA V ELEKTROROZHDENII $e^- + p \rightarrow e^- + n + \pi^+$ I ELEKTROMAGNITNYI FORMFAKTOR π^+ MEZONA. (Asymmetry in the $e + p \rightarrow e + n + \pi^+$ Electroproduction and Electromagnetic Form Factor of π^+-Meson). Goryachkin, V. G.; Semikoz, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 16p. (In Russian). Dep.

Asymmetry in the process of the $e + p \rightarrow e + n + \pi^+$ electroproduction on the polarized proton target is calculated with the aid of the Fubini, Nambu, Watagin resonance model. In the framework of this model the asymmetry is determined by the electromagnetic form factor of π^+-meson. It is shown that the asymmetry is more sensitive to the form factor than the cross section on the nonpolarized target. Possible experiments are pointed out for checking the model. (auth)

26593 ELECTRON TRIDENT AND PAIR PRODUCTION AT 500 MeV. Grossetete, B. (Laboratoire de l'Accelerateur Lineaire, Orsay, France); Tchapoutian, R.; Drickey, D. J.; Yount, D. Phys. Rev., 168: 1475-94(Apr. 25, 1968).

The cross sections, differential in the recoil positron energy, for trident and quartet production and for bremsstrahlung followed by pair and triplet production were measured for beryllium, aluminum, and platinum targets at a nominal incident electron energy of $E_0 = 500$ MeV and for recoil positron energies in the range above $0.80\ E_0$. The estimated experimental errors are about ±6% for the direct process and about ±3% for the double process at most points. The (pair + triplet) data for all three elements are in excellent agreement with theoretical predictions which contain detailed screening calculations and which take into account electron-electron bremsstrahlung and pair production in the electron field. A satisfactory fit (χ^2 probability 0.22) to the (trident + quartet) data was obtained with the no-screening cal-

culations of Murota, Ueda, and Tanaka when the integration parameter (α in their notation) had a value 0.75 ± 0.05 and when quartets were taken into account by the substitution $Z^2 \rightarrow Z(Z + \eta)$, where η is the ratio of the total cross sections for electron-electron and electron-nucleon bremsstrahlung. If the timelike photon contributions, which amount to roughly 35% of the net cross section, are left out, the integration parameter has an optimum value of 2.00 ± 0.20. The corresponding χ^2 probability is much less than 0.01, indicating the necessity of the timelike terms. (auth)

26594 ESTIMATE OF THE SIXTH-ORDER CONTRIBUTION TO THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON. Parsons, Ronald G. (Stanford Linear Accelerator Center, Calif.). Phys. Rev., 168: 1562-7(Apr. 25, 1968). (SLAC-PUB-354).

An improvement of the estimate by Drell and Pagels of the anomalous magnetic moment of the electron is given. Use is made of a sidewise dispersion relation in which the mass W^2 of one of the external electron lines is analytically continued off its mass shell. Only one-electron, one-photon states are retained in the absorptive amplitude, but this is sufficient to obtain all terms in the absorptive part of the anomalous moment proportional to $(W^2 - m^2)$ and $(W^2 - m^2)^2$ as $W^2 \rightarrow m^2$. This calculation relates $\frac{1}{2}(g - 2)$ to the Compton amplitude in its exact threshold region. An expansion is made in powers of the photon energy in the Compton amplitude rather than a perturbation calculation in powers of $\alpha \approx 1/137$. The Schwinger term $\alpha/2\pi$ is reproduced exactly. A cutoff is chosen so that the fourth-order term is $-0.328\alpha^2/\pi^2$ approximately reproduced. This cutoff leads to an estimate of the sixth-order term of $\approx +0.13\alpha^3/\pi^3$. (auth)

26595 HIGH-ORDER LOW-ENERGY THEOREMS FOR NUCLEON COMPTON SCATTERING. Choudhury, S. Rai (Princeton Univ., N. J.); Freedman, D. Z. Phys. Rev., 168: 1739-45(Apr. 25, 1968).

The well-known zero- and first-order (in photon energy) low-energy theorems for nucleon Compton scattering have recently been derived by Abarbanel and Goldberger using only the physical helicity amplitudes for the process and exploiting their kinematical singularities and zeros. This approach is used to study higher-order terms in photon energy and to obtain the result, not entirely new, that four of the six independent helicity amplitudes are determined in second order by the mass, charge, and magnetic moment of the nucleon. Therefore, these parameters together with two structure-dependent constants, which can be interpreted approximately as electric and magnetic polarizabilities, completely determine the Compton scattering to second order in energy. Similar simplifications occurring in the structure of higher-order terms in energy are also discussed. The kinematical singularity structure of helicity amplitudes is a manifestation of Lorentz invariance. It is claimed to have fully exploited the requirements of Lorentz invariance and therefore to have derived the complete set of low-energy theorems for this process. (auth)

26596 MODEL FOR ELECTRON EXCITATION OF THE NUCLEON. II. Pritchett, P. L.; Walecka, J. D. (Stanford Univ., Calif.). Phys. Rev., 168: 1638-61(Apr. 25, 1968).

The model of oscillations of the meson field in the nucleon introduced in a previous paper is developed and extended. The model provides a dynamical framework for investigating the electromagnetic properties of the nucleon and gives an excitation spectrum similar to that observed for the nucleon. An improved variational solution for the ground-state meson field and the construction of a conserved current are discussed. The problems presented by a fixed-source theory and the linearization of the ϕ^4 theory in constructing this current are investigated. A model for the current allows all the electromagnetic properties of the nucleon on a consistent basis to be calculated. The allowed transverse and Coulomb electron scattering form factors are calculated for all the levels of the nucleon up through 2850 MeV, and are compared with existing data wherever possible. What is known from phenomenological analysis of photoproduction is also compared. Using the magnitude of the ground-state field obtained from a fit to the experimental inelastic form factors, the anomalous magnetic moment of the nucleon and the pion-nucleon coupling constant can be computed. The parameters are also used to investigate the elastic form factors. It is shown that our model is the appropriate limit of the coupled equations of motion for the meson field and the spin and isospin of the nucleon source. The model is only very crude, but it does indicate some of the interesting things that can be learned from electron excitation of the nucleon. (auth)

26597 NEW SUM RULE FOR ELECTROMAGNETIC MASS DIFFERENCES. Yamamoto, Kunio (Syracuse Univ., N. Y.). Phys. Rev., 168: 1677-9(Apr. 25, 1968).

A new sum rule which is valid for both $|\Delta I| = 1$ and $|\Delta I| = 2$ mass differences is derived. It gives a reasonable value for the kaon mass difference which cannot be computed by Cottingham's sum rule. It is shown that the new sum rule reduces to that of Cottingham if the latter sum rule exists. (auth)

26598 PERIPHERAL ELECTROMAGNETIC INTERACTIONS OF THE FAST CHARGED PARTICLES AND NUCLEONS. Wang, P'ei. Chin. J. Phys. (Peking) (Engl. Transl.), 21: 1943-56 (Aug.-Dec. 1965).

Translated from Wu Li Hsueh Pao, 21: 1533-43(Aug. 1965).

A study was made of the influence upon the modification of the theory of equivalent photon spectrum by Weizsäcker-Williams, given by the electromagnetic structure of the nucleon. To overcome the difficulty caused by the divergence in the calculation with the form factor of the Clementel-Villi's type, a method of modifying the form factor is also suggested. The results of the calculation show that within the region in which the method of the equivalent photon spectrum works, the results conform to the Weizsäcker-Williams theory, if the masses for the two particles in collision are considerably different; however, the influence of the structure is very evident, if the masses of the two particles are approximately equal. (auth)

26599 PERTURBATIVE APPROACH TO SUPERCONVERGENCE RELATIONS AND CURRENT ALGEBRA. Bardakci, K. (Univ. of California, Berkeley); Halpern, M. B.; Segre, G. Phys. Rev., 168: 1728-30(Apr. 25, 1968).

Using unitary representations of the Lorentz group, and expanding in powers of mass splitting, a perturbative approach to superconvergence relations and current algebra is introduced. (auth)

26600 SUGGESTED BOSON-LEPTON PAIR COUPLINGS AND THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. Brodsky, Stanley J. (Stanford Linear Accelerator Center, Calif.); de Rafael, Eduardo. Phys. Rev., 168: 1620-2(Apr. 25, 1968). (SLAC-PUB-366).

The contributions to the anomalous magnetic moment of the muon due to possible couplings of scalar and vector bosons to lepton pairs are calculated to second order. From the results obtained and the comparison between the experimental and theoretical values of $\frac{1}{2}(g - 2)_\mu$, new stringent tests of several theories which have been recently put forward are found. (auth)

26601 "ABSORPTION EFFECTS" FOR HIGH-ENERGY PHOTONS. Kramer, G. (Institut fuer Experimentalphysik, Hamburg); Schilling, K.; Stodolsky, L. Nucl. Phys., B5: 317-24(1968).

The contribution of the intermediate vector-meson state in photoproduction is equal in strength to the direct Born terms and, when combined with the Born term, can give an effect simulating strong absorption for the photon. (auth)

26602 ALGEBRA OF FIELDS AND ELECTROMAGNETIC MASS DIFFERENCES. Mueller, V. F. (Univ., Heidelberg. Kernforschungszentrum, Karlsruhe, Ger.); Rothleitner, J. Nucl. Phys., B5: 373-80(1968).

Using the algebra of fields and the nonleptonic weak interaction in the local form the "divergent" part of the electromagnetic mass differences of the hadrons is expressed in terms of parity-violating non-leptonic weak decay amplitudes. Octet dominance is found in that part with the same d/f ratio as the corresponding weak matrix elements. As our main result the ratio $|(m_{K^+} - m_{K^0})/(m_n - m_p)| \approx 2.7$ is predicted. (auth)

26603 FINITE ENERGY SUM RULES IN NUCLEON COMPTON SCATTERING. Fox, J. R. (Imperial Coll. of Science and Tech., London). Nucl. Phys., B5: 331-9(1968).

A class of finite-energy sum rules is derived, involving photoproduction cross sections, which provides a check of the hypothesis of analytic amplitudes and which enables one to predict, from low-energy data, the values of $\alpha(0)$ for the Pomeranchuk, A_2, A_1 and D trajectories. The present experimental situation does not permit useful numerical calculations. The Drell-Hearn and other superconvergence sum rules are also discussed. (auth)

26604 MULTIPOLE ANALYSIS OF PION PHOTOPRODUCTION BELOW THE FIRST RESONANCE. Wennstroem, Tomas (Univ. of Lund, Sweden). Nucl. Phys., B5: 235-49(1968).

Different sets of multipoles are derived phenomenologically from the experimental differential cross section data of both π^+ and π^0 production. This is done by an iterative method using the multipoles of Berends, Donnachie and Weaver as a zeroth-order approximation. Predictions of experimental values of asymmetry ratios and recoil proton polarization are given. The energy region below the first resonance is examined. (auth)

26605 PHOTOPRODUCTION OF CHARGED π-MESONS ON CARBON AND OXYGEN NUCLEI. Korenman, G. Ya.; Mar'-

yanovskaya, L. L. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 6, 117-18(Nov.–Dec. 1967). (In Russian).

General problems in the theory of partial transitions during photoproduction of charged π mesons on light nuclei, within the limitations of the pulse approximation, were studied previously by V. V. Balashov et al, (Nuclear Phys. 1: 668, 1965). Further studies were made of the partial transitions in reactions $\gamma + {}^{12}C \rightarrow {}^{12}N + \pi^-$, and $\gamma + {}^{16}O \rightarrow {}^{15}N + \pi^+$ with the production of daughter nuclei in bound states. (R.V.J.)

26606 RADIATIVE CORRECTIONS TO SYMMETRIC PAIR PRODUCTION. Huld, B. (Harvard Univ., Cambridge, Mass.). Contract AT(30-1)-2752. Phys. Rev., 168: 1782-94(Apr. 25, 1968).

The radiative corrections to symmetric pair production are calculated to a high degree of accuracy. The matrix element squared for the hard-photon correction is expressed approximately in a simple form which, for symmetric pair production, describes the corresponding radiative correction to better than 1%. This approximation improves on the often-used peaking approximation. The results are useful also for calculating radiative corrections to bremsstrahlung and trident production. (auth)

26607 PHENOMENOLOGICAL ANALYSIS OF THE γNN^* FORM FACTORS. Dufner, A. J.; Tsai, Y. S. (Stanford Linear Accelerator Center, Calif.). Phys. Rev., 168: 1801-9(Apr. 25, 1968). (SLAC-PUB-364).

The data on electroexcitation of N^* in the momentum-transfer range $-q^2 = 0.1 - 2.33$ GeV^2 were analyzed phenomenologically, using an isobar model. Assuming only the M1 transition, a phenomenological form factor was obtained for the γNN^* vertex. This form factor is found to decrease much faster than the elastic nucleon form factors. This implies that N^* has a larger spatial extension than the N. (auth)

26608 KINEMATIC SINGULARITIES OF HELICITY AMPLITUDES FOR COMPTON SCATTERING. Freedman, Daniel Z. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 168: 1822-6(Apr. 25, 1968).

The kinematic-singularity structure of helicity amplitudes for Compton scattering from arbitrary-spin hadron targets is obtained by an analysis based on the crossing relations. Explicit formulas are given for a complete set of amplitudes free of kinematic singularities and zeros in both variables. These amplitudes are, however, subject to constraint conditions at special points. The constraints are not studied here. (auth)

26609 PHENOMENOLOGICAL ANALYSIS OF NEUTRAL PION ELECTROPRODUCTION AND THE γNN^* FORM FACTOR. Imrie, D.; Mistretta, C.; Wilson, Richard (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 20: 1074-8(May 6, 1968.

Recent data on neutral pion electroproduction in the region of the $N^*(1236)$ resonance were analyzed phenomenologically to determine the magnitude of the dominant magnetic dipole amplitude and its interference with the E_1^+ electric quadrupole amplitude. Evidence is found for the existence of significant scalar multipoles. The four momentum-transfer dependence of the magnetic dipole amplitude is interpreted in terms of the γNN^* transition form factor between 0.05 and 0.4 (BeV/c)^2. (auth)

26610 ON THE THEORY OF COMPTON SCATTERING OF ELIPTICALLY POLARIZED PHOTONS BY A PARTICLE OF 1/2 SPIN. Kukanov, A. B.; Amer, A. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 11, 103-6(1967). (In Russian).

Formulas were obtained for the differential effective cross section of the scattering of elliptically polarized photons on point, originally at rest, Dirac particles, having electrical charge and abnormal magnetic field. The particular case of scattering linearly polarized and circularly polarized photons was investigated. The case when the incident radiation was nonpolarized was examined. (tr-auth)

Weak

Refer also to abstracts 26590 and 26670.

26611 (LAL–1189) K^0 THREE BODY DECAYS. Aubert, B. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Mar. 1968. 39p. Dep.

The $K^0 \rightarrow 3\pi$ and $K^+ \rightarrow 3\pi$ decays and also leptonic decays are reviewed. The discussion includes PC violation in $K^0 \rightarrow 3\pi$ decay, current algebra predictions for the $K \rightarrow 3\pi$ spectra, and the selection rule and form factor for $K^0 \rightarrow \pi^- + e^+ + \nu$ decays, and the $K \rightarrow \pi + l + \nu$ amplitude, branching ratio, and total polarization. (J.F.P.)

26612 K_{l3} FORM FACTORS FROM PARTIALLY CONSERVED AXIAL-VECTOR CURRENT AND CURRENT ALGEBRA. McNamee, Peter (Woodstock Coll., Md.). Phys. Rev., 168: 1683-91(Apr. 25, 1968).

The form factors for the K_{l3} decay ($K \rightarrow \pi\pi\pi l\nu_l$) are derived through the use of the algebra of currents and the hypothesis of partially conserved axial-vector current. In obtaining the results, two different methods were used: the single-soft-pion method, in which the momentum of only one pion at a time is set equal to zero, and the multi-soft-pion method, in which all pions in the matrix element are taken off the mass shell simultaneously. The results obtained by the two methods are consistent one with the other; the existence of a pole in the form factors in the limit of two soft pions indicates, however, that the matrix element obtained in the limit of three soft pions is not a valid approximation to the matrix element in the physical region. The $K\pi$ and $\pi\pi$ scattering amplitudes and the transformation properties and matrix elements of the σ field are also discussed, since they are intimately connected with the derivation of the K_{e3} form factors. The rates obtained for the four possible K_{e3} decay modes were found to be $\sim 10^{-3}$–10^{-4} sec^{-1}. (auth)

26613 POLARIZATION CORRELATIONS IN HIGH-ENERGY NEUTRINO REACTIONS. Florescu, Viorica; Minnaert, Pierre (Centre de Physique Theorique de l'Ecole Polytechnique, Paris). Phys. Rev., 168: 1662-76(Apr. 25, 1968).

A study is made of the neutrino-induced reaction $\nu_\mu + N \rightarrow B + \mu$ and the two-step reactions of the type $\nu_\mu + N \rightarrow B^* + \mu$, $B^* \rightarrow B + \pi$, where B^* is a baryonic resonance of arbitrary half-integer spin $S = \frac{1}{2}, \frac{3}{2}, \ldots$. The polarizations of the final particles B and μ and the correlations between these polarizations are calculated, the initial nucleon N being arbitrarily polarized. For the two-step process, the calculation is performed in two stages. First, assuming the usual current × current form for the weak interactions, the spin-density matrix of the B^* produced at the first step is calculated; then its strong decay into the baryon B and the pion is calculated. It is shown that, using a convenient formalism to describe the baryonic resonance B^*, this procedure for the calculation allows one to reduce the γ-matrix calculation in the case of an arbitrary spin S to that of the case $S = \frac{1}{2}$. Some tests of time-reversal invariance are considered for the elastic process. (auth)

26614 DYNAMICAL APPROACH TO THE NONLEPTONIC DECAYS. Guralnik, G. S. (Univ. of Rochester, N. Y.); Mathur, V. S.; Pandit, L. K. Phys. Rev., 168: 1866-71(Apr. 25, 1968). (UR-875-216).

An assumption about the structure of single-particle matrix elements of the weak nonleptonic Hamiltonian is suggested and motivated. Using this assumption together with the algebra of currents, the S- and P-wave decays of hyperons, and the K decays are calculated, and are found to be in good agreement with experiment. (auth)

26615 PION PHASE-SHIFT INFORMATION FROM K_{l4} DECAYS. Pais, A.; Treiman, S. B. (Rockefeller Univ., New York). Phys. Rev., 168: 1858-65(Apr. 25, 1968).

The structure of the K_{l4} decay spectrum is displayed in its full generality as a function of a complete set of five kinematic variables; polarization effects are in part similarly described. The nontrivial dynamical aspects of K_{l4} decay reside in certain form factors, which depend on only three of the variables. It is shown that, with large cuts at the two remaining variables, the measurement of the decay spectrum alone suffices to overdetermine the form factors. On certain standard assumptions, these form factors carry information relating to the phase shifts for pion-pion scattering. It is an important practical matter to extract something of this information under conditions of limited statistics, where the spectra have to be treated in partially integrated form. It is found that this can be accomplished, with surprising economy, for the energy-dependent phase-shift difference $\delta_s - \delta_p$, on the single additional assumption that the dipion system is produced chiefly in s- and p-wave states. The information emerges from the intensity spectrum for K_{e4} decay, and again from the polarization spectrum for $K_{\mu 4}$ decay, the spectra being treated as functions of only three variables. Moreover, the structure in two of these variables is simple and therefore relatively undemanding in a statistical sense. (auth)

26616 PERTURBATION THEORY OF PION DECAYS. Wellner, Marcel (Syracuse Univ., N. Y.). Phys. Rev., 168: 1855-8(Apr. 25, 1968).

To first order in the pion-baryon couplings, the Feynman diagram for the decay $\pi \rightarrow \mu + \nu$ essentially consists of a baryon loop. By requiring it to be finite, one obtains a linear relation between the coupling constants $g_{\pi N}$, $g_{\pi\Sigma}$, and $g_{\pi\bar{z}}$. (The coupling to the $\Lambda\Sigma$ system plays no role here.) A very simple choice of values is conjectured, which produces good agreement with experiment for both the charged and neutral pion decays, when these are calculated to first order in $g_{\pi N}$. (auth)

26617 MESONIC EXCHANGE EFFECTS IN β DECAYS. Yap, C. T. (Univ. of Singapore). Nucl. Phys., B5: 369-72(1968).

It is shown that if the conserved vector current theory is not valid then for $\Delta J = 0$, $\Delta T = \pm 1$ beta decays the Fermi nuclear matrix elements due to mesonic exchange currents in the nucleus are as large as those due to charge-dependent effects. (auth)

26618 RADIATIVE CAPTURE OF μ-MESON BY ELECTRON. Safronov, A. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 6, 25-31(Nov.-Dec. 1967). (In Russian).

Angular and energy distribution of photons accompanying two-neutrino annihilation of $\mu + e^-$ pair was studied. These photons offer the data on $(e\bar{\nu}_e)$ $(\bar{\nu}_\mu\mu)$ interactions at a certain energy region the cross section of the examined process exceeds significantly the cross section corresponding the two-particle reaction. (tr-auth)

26619 RADIATIVE CORRECTIONS TO WEAK PION DECAYS. Snellman, H. (NORDITA, Copenhagen). Nucl. Phys., B5: 220-34 (1968).

The radiative corrections to the π_{e2} decay are studied using current algebra techniques. To first order in α and all orders in the strong interactions the same divergent parts are found as in the π_{e3} decay. It is also shown that to lowest order in the weak coupling but to all orders in the strong interactions and in α the radiative corrections to the π_{e2} decay and the π_{e3} decay are the same provided the π^0 meson has vanishing four-momentum. The results are true boih with the local current-current interaction and in the intermediate weak boson theory. (auth)

26620 β DECAY OF LIGHT HYPERNUCLEI. Block, M. M. (Northwestern Univ., Evanston, Ill.). Phys. Rev., 168: 1795-1800 (Apr. 25, 1968).

The β decay rates for the hypernuclear decays (1) ${}_\Lambda H^4 \rightarrow e^- + \bar{\nu} + {}^4He$, (2) ${}_\Lambda H^4 \rightarrow$ all e^-, (3) ${}_\Lambda He^4 \rightarrow$ all e^-, (4) ${}_\Lambda H^3 \rightarrow e^- + \bar{\nu} + {}^3He$, and (5) ${}_\Lambda H^3 \rightarrow$ all e^- are calculated. Reaction (1), which is a spin $0 \rightarrow 0$ transition, allows us to isolate and measure the vector coupling constant for Λ β decay. The feasibility of experiments using a helium bubble chamber is discussed. (auth)

26621 $K_L^0 \rightarrow \mu^+ + \mu^-$ DECAY, $K_L^0 - K_S^0$ MASS DIFFERENCE, AND WEAK-INTERACTION CUTOFF. Mohapatra, R. N.; Rao, J. Subba; Marshak, R. E. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 20: 1081-4(May 6, 1968).

Upper and lower limits for the weak-interaction cutoff are obtained from current-algebra calculations of the second-order processes $K_L^0 \rightarrow \mu^+\mu^-$ and $K_L^0 - K_S^0$. (L.B.S.)

26622 COUPLING OF THE NUCLEONIC AND MUONIC CURRENTS IN ELASTIC NEUTRINO–NUCLEON INTERACTIONS. Kerimov, B. K.; Kasumov, Yu. M. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 11, 15-22(1967). (In Russian).

The spin dependence of the neutrino-nucleon interaction with formation of the muon $\nu(\bar{\nu})N \rightarrow N'\mu$ was investigated in the assumption of the point nucleon with respect to the two-component and four-component two-neutrino theory. The difference in the predictions of these two theories was indicated. It was shown that the two-neutrino four-component theory, in contrast to the two-component theory, allows the $V + \lambda A$ variant of the interaction of the muon current $(\bar{\mu}\nu')$ with the baryon current. (tr-auth)

26623 SUPERWEAK INTERACTIONS AND DOUBLE BETA DECAY. Pontecorvo, B. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett., 26B: 630-2(Apr. 15, 1968).

The possibility of neutrinoless double beta decay induced by superweak interactions in ^{128}Te and other nuclei is studied by comparison with two-neutrino double beta decay. (L.B.S.)

26624 DYNAMICAL MODEL OF NONLEPTONIC DECAYS AND SCALAR MESONS. Loebbaka, David Scott. College Park, Md., Univ. of Maryland, 1967. 179p.

Thesis.

A consequence of a dynamical model for nonleptonic decays is investigated. The basis for the model is the assumption that the matrix elements, written in terms of initial state minus final state momenta, are dominated by the low-mass mesons in a sense of dispersion theory. In the parity violating amplitudes, this assumption corresponds to the nonleptonic decays being dominated by the $K_1^0 \rightarrow$ vacuum transition. It was pointed out that such a model is forbidden in the limit of SU(3) symmetry. It is shown, however, that the physical amplitudes do not necessarily reflect this forbiddeness. The parity violating nonleptonic hyperon decay amplitudes are fit in this model, and it is shown that it is possible to fit the ratios of the weak decay amplitudes with coupling constants determined solely by the strong interactions. For the parity conserving amplitudes, the existence of a scalar meson (κ) with $|I| = \frac{1}{2}$ and $|Y| = 1$ is assumed. This model leads to a reasonable fitting of the parity conserving nonleptonic hyperon decay amplitudes. This unified picture for the nonleptonic hyperon decays allows predictions of cascade decay parameters which are in reasonable agreement with experiment. In addition, it is shown that the $\Lambda \rightarrow p + \pi^-$ and $\Sigma^+ \rightarrow n + \pi^-$ decay parameters lead to a prediction that $\Sigma^- \rightarrow n + \pi^-$ occur via pure S-wave. Information is also obtained on the baryon-scalar meson octet coupling constants. The model is extended to a discussion of the $K_1 \rightarrow 2\pi$ decay and the K_1, K_2-mass difference. Scalar meson poles would be expected to play a dominant role in such a model. Possible candidates for these scalar mesons are discussed and it is shown that the existence of the nonet scalar meson may have an important bearing on the $|\Delta Y| = 1$ transitions. In particular it is argued that one of the $I = Y = 0$ scalar mesons is preferred to have a mass close to the K-meson (say 510 MeV $< m_\sigma <$ 560 MeV) for a unified understanding in this model of the $K_1 \rightarrow 2\pi$ rates and of the magnitude and sign of the $K_1 - K_2$ mass difference. Finally, the strong and electromagnetic decays of an $I = 1$, $Y = 0$ meson are discussed. It is shown that an enhancement observed in a $\pi^- + p$ recoil spectrum and not seen in two or three pion final states is a reasonable candidate for a scalar meson with $J^{PC} = 0^+$. (Disser. Abstr.)

Strong (General)

Refer also to abstract 27088.

26625 DYNAMICS IN THE BRONZAN–LEE MODEL. North, Gerald R. (Univ. of Pennsylvania, Philadelphia). Contract AT(30-1)-2171. Phys. Rev., 168: 1698-1701(Apr. 25, 1968). (NYO-2171-237).

The nonrelativistic Bronzan-Lee model is solved by the method of old-fashioned strong-coupling theory. The isobar physical states are derived in terms of the bare parameters, and all the renormalization constants are calculated. It is argued that taking all the bare couplings to infinity leads to a bootstrap solution. (auth)

26626 FIXED-ANGLE DISPERSION APPROACH TO THE INDUCTION OF STRONG-INTERACTION SYMMETRIES. Capps, Richard H. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 168: 1731-8(Apr. 25, 1968). (COO-1428-36).

Dispersion relations for forward and backward MM and Mb scattering amplitudes are considered, where the M and B are hypothetical, separately degenerate sets of mesons and baryons. Self-consistency conditions for the quantum numbers and three-particle interaction constants for the particles are obtained from the hypothesis that the dispersion integrals are saturated with poles associated with the M and B states in the s, t, and u channels. The spin components are treated on the same footing as the internal quantum numbers. If a subset of the mesons is connected with interactions antisymmetric in the exchange of two mesons, this subset must correspond to the regular representation of a compact, simple Lie group, as in Cutkosky's model of vector mesons. On the other hand, mesons and baryons of both parities must be present in this model. If all the helicity states of the odd-parity mesons have nonzero interactions, the mesons must be vector and pseudoscalar mesons, and the Lie group must contain SU(2) as a noninvariant subgroup applied to the spins according to the W-spin prescription. An SU(6) w-symmetric solution to the model is discussed briefly. This solution is similar to that obtained previously from partial-wave dispersion relations, and is in agreement with the experimental hadron spectrum. (auth)

26627 FORM FACTORS AND VECTOR-MESON DYNAMICS. Drummond, Ian T. (State Univ. of New York, Stony Brook). Phys. Rev., 168: 1550-6(Apr. 25, 1968).

It is suggested that the isovector form factors of various particles will have a common shape arising from a common dynamical determinant. This leads naturally to a product-of-poles shape for the form factors. Two models are considered for the isoscalar form factors. The first, which supposes that the ϕ-ω mixing angle is energy-independent, agrees with the result of Krohn and Ringo for $G_E^\omega(0)$ only if the baryon normalization is very different from that of the quark model. The second involves an energy-dependent mixing angle and permits the quark model to be consistent with experiment. The theory assumes that the mixing angle vanishes at $t = 0$. (auth)

26628 NEW SUPERCONVERGENCE RELATIONS FOR MESON–BARYON AND BARYON–BARYON SYSTEMS. Gupta, Y. M.; Rangwala, A. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 168: 1701-5(Apr. 25, 1968).

New superconvergence relations, using Regge asymptotic behavior, were written down for the meson-baryon and the baryon-baryon systems. The πN, $\bar{K}N(KN)$, $NN(N\bar{N})$ processes for which enough experimental data on total cross sections are available to evaluate the integrals occurring in the sum rules are discussed. The results obtained are in agreement with experiments. (auth)

26629 NONRELATIVISTIC QUARK MODEL. Levin, E. M.; Frankfurt, L. L. Usp. Fiz. Nauk, 94: 243-88(Feb. 1968). (In Russian).

On the basis of the symmetry relations in nuclear physics, it is possible to develop a quasinuclear model of strongly interacting particles, assuming that these hadrons contain certain fundamental components. The first such attempts were made by Fermi and Yang in connection with their study of π mesons, involving nucleons and antinucleons. After the discovery of strange particles, Sakata increased the number of fundamental particles to 3,-proton, neutron and λ hyperon and the corresponding antibaryons. On the basis of Gell-Mann and Zweig's concept of triplet particles, designated as quarks and antiquarks, it appeared possible to classify elementary particles and to develop special models. The development of the nonrelativistic quark model is reviewed on the basis of quantum mechanical considerations, comparing the quarks with the symmetry systems. The assumption that mesons consist of baryons and independent particles was experimentally confirmed but no free quarks have been found. Application of the nonrelativistic model presents problems: it is not clear how the quarks conserve their individuality within hadrons. New high-energy accelerator experiments are needed to clarify the boundaries of the mass of quarks. (Review article, 97 references). (TTT)

26630 QUARK MODEL WITH FACTORIZABILITY ASSUMPTION. Kawaguchi, Masaaki; Sumi, Yoshio; Yokomi, Hiroyuki (Osaka Univ.). Phys. Rev., 168: 1556-61(Apr. 25, 1968).

Characteristic features of the hadron-hadron elastic scattering at high energies are explained in the quark model with a factorizability assumption. The factorizability assumption is that the elastic amplitude $F(\theta)$ is assumed to be proportional to a product of the probability amplitude of each constituent quark scattered at an angle θ (and $\pi-\theta$, if possible). Various relations for the differential cross sections are obtained, together with those for the total cross sections. For example, relations such as $\sigma_{K^-p}^T = \sigma_{K^-p}^T$, $\sigma_{pp}^T - \sigma_{p\bar{p}}^T \cong 5(\sigma_{p\bar{n}}^T - \sigma_{pp}^T)$, $(d\sigma_{\pi^+p}/dt)$ $(d\sigma_{K^-p}/dt)$ $(d\sigma_{pp}/dt) = (d\sigma_{\pi^-p}/dt)$ $(d\sigma_{K^+p}/dt)$ $(d\sigma_{p\bar{n}}/dt)$ were obtained, and the conclusion that the ratio $(d\sigma_{\pi^+p}/dt)/(d\sigma_{K^+p}/dt)$ is θ-independent; these are essentially different from the results obtained from the usual quark model with the additivity assumption. At $\theta = 90°$, the relations become especially simple, and experimental tests of our model seem to be feasible. For the backward scattering, the model also predicts several relations which are qualitatively in good agreement with experiments on pion-, kaon-, and nucleon-nucleon scattering. (auth)

26631 INTERACTION RADII OF STRONGLY INTERACTING PARTICLES. Miyashita, S.; Libby, L. Marshall (Univ. of Colorado, Boulder). Contract AT(11-1)-1537. Phys. Rev., 168: 1779-81(Apr. 25, 1968).

Interaction radii for pairs of excited elementary particles are computed from differential production cross sections by a simple model. It is found that the excited states of baryons and mesons consistently have interaction radii smaller than the ground states, and that they expand slowly with energy, corresponding to a shrinkage of the diffraction region, up to center-of-mass energies of 15 GeV or so. It is probable that there is very little more expansion at higher energies. (auth)

26632 MULTIPION BOUND STATES IN A σ MESON. Levy, Donald J.; Cornwall, John M. (Univ. of California, Los Angeles). Phys. Rev., 168: 1832-40(Apr. 25, 1968).

The possible existence of multipion nonrelativistic bound states is examined with variational principles. It is found that of two likely candidates (the η meson, and a possible σ meson with I = J = 0 and even parity), only the σ can be a bound state of 4 pions. If the η were bound, there would unavoidably be a three-pion bound state with the quantum numbers of the ω and mass $<3m_\pi$. The four-pion channel couples to the two-pion channel, which turns the σ into a resonance. The multichannel problem is investigated with an N/D method, which yields an estimate of the width of the σ resonance. A theorem of Blankenbecler is used to dispose of the difficulties of anomalous thresholds. Crude calculations show that the physical σ should lie above the four-pion threshold. (auth)

26633 RELATIONS BETWEEN PARTIALLY CONSERVED AXIAL-VECTOR CURRENT, AXIAL-VECTOR CHARGE COMMUTATION RELATIONS, AND CONSPIRACY THEORY. Mandelstam, Stanley (Univ. of California, Berkeley). Phys. Rev., 168: 1884-93(Apr. 25, 1968).

The Adler self-consistency condition is shown to be true without reference to currents, provided that the pion trajectory is a member of a conspiracy with $|M| \geq 1$. It is then shown from the Adler self-consistency condition that the antisymmetric part of the amplitude for forward scattering of low-energy low-mass pions off any target is equal to a universal constant multiplied by the isotopic spin of the target. Thus all restrictions which current algebra imposes on hadron scattering amplitudes can be derived from conspiracy theory; production amplitudes are not examined here. The question whether a system which contains massless pions satisfying the Adler self-consistency condition possesses a conserved axial-vector current is investigated. Assuming that the usual Omnes-type equation can be solved, it is found that it does. Finally, the commutation relations between total axial-vector charges are shown to follow from the conservation equation under very general assumptions. (auth)

26634 LOW-ENERGY ELECTRON SPECTRUM FROM THE DECAY OF UNPOLARIZED MUONS. Grotch, H. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 168: 1872-4(Apr. 25, 1968).

An exact expression for the electron spectrum from the decay of unpolarized muons, including first-order radiative corrections, was previously calculated by Kinoshita and Sirlin assuming a V–A theory of weak interactions. Most results in the literature, however, have been expressed in the limit of small electron mass, this approximation being valid if the electron's energy is greater than about $10m_e$. The exact spectrum is presented, and other approximations are used to derive simple formulas useful in the ranges $E_e > 3m_e$ and $E_e < 3m_e$. In the low-energy region, it is shown that the spectrum is dominated by the emission of non-infrared photons from the electron. The results are compared with the Michel formula (no radiative corrections) for $E_e \leq 0.1M_\mu$. (auth)

26635 SINGULARITIES OF THE REGGE-POLE MODEL AT MASS ZERO. Omnes, R. L. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Rev., 168: 1893-5(Apr. 25, 1968).

The behavior of a Regge-pole expansion when the mass of a physical particle tends to zero is considered. If this variation of the mass is obtained by letting some parameter λ vary, it is found that the analytic form of the residues must change discontinuously when the mass passes through zero. Such an effect is called a transition, by analogy with statistical mechanics. Some consequences are given concerning the reliability of perturbation expansion, zero-mass pions and their Toller classification, and the Pomeranchuk singularity. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 26615 and 26652.

26636 (JINR–P2-3590, pp 38-43) O NELOKAL'NYKH TEORIYAKH I O VOZMOZHNOSTI POSTROENIYA SOSTAVNYKH MODELEI IZ KVARKOV. (Nonlocal Theories and a Possible Construction of Models Consisting of Quarks). Watagin, G. V. (Turin Univ. (Italy)). (In Russian).

26637 (JINR–P2-3590, pp 183-93) SISTEMA S GAMIL'TONIANOM V VIDE ZAVISYASHCHEI OT VREMENI KVADRATICHNOI FORMY OT KOORDINAT I IMPUL'SOV S TOCHKI ZRENIYA KVANTOVOI TEORII POLYA. (A System with the Hamiltonian as a Time-Dependent Quadratic Form of the Coordinates and Momenta from the Point of View of Quantum Field Theory). Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). (In Russian).

26638 CURRENT ALGEBRAS AND POLE DOMINANCE A CONSISTENT TREATMENT OF THE A$\rho\pi$ SYSTEM. Brown, Stanley G.; West, Geoffrey B. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 168: 1605-19(Apr. 25, 1968).

A new technique for obtaining consistent solutions to the current-algebra equations for vertex functions in the pole-dominance approximation is developed and applied to the A$\pi\rho$ system. Matrix elements of the retarded commutator of two currents (or of one current and $D_A \equiv \partial_\mu A^\mu$) taken between single-particle states (the π, A, and ρ mesons) and the vacuum are considered. The absorptive parts of such amplitudes contain terms proportional to $\delta(q^2-m_\pi^2)$ and $\delta(\Delta^2-m_\pi^2)$, for example; it is demonstrated that erroneous results are obtained if unsubtracted dispersion relations (UDR) at either fixed q^2 or Δ^2 are assumed for these matrix elements. Unsubtracted dispersion relations are therefore written at fixed $\mu \equiv \alpha q^2 + (1-\alpha)\Delta^2$, where α is an arbitrary number (unequal to zero or one). Consistent solutions to the current-algebra equations are then derived. Several sum rules involving the $\rho \to \pi\pi$ and $A \to \rho\pi$ couplings are derived, as well as the first Weinberg sum rule. The method, and the difficulties of earlier calculations based upon fixed-q^2 UDR, are discussed in detail. A careful discussion of the relevant experimental quantities is given. These include the ρ and A widths, the pion form factor, and the structure-dependent radiative pion decay. There is good order-of-magnitude agreement between theory and experiment. (auth)

26639 INVESTIGATION OF THE ρ BOOTSTRAP AND THE DETERMINANTAL APPROXIMATION. Atkinson, D.; Ong, Kwok

Maw (Univ. of California, Berkeley). Phys. Rev., 168: 1692-7 (Apr. 25, 1968).

The ρ bootstrap is considered critically by comparing the results of a δ-function and a Breit-Wigner exchange. It is found that the self-consistent solution that exists for the δ-function case is not reproduced by the Breit-Wigner input. The reason for this is traced to an abnormally large repulsive long-range contribution in the δ-function case that is absent in the Breit-Wigner exchange. It is concluded that the ρ bootstrap is in serious trouble. (auth)

26640 LORENTZ POLE STRUCTURE AND t = 0 KINEMATIC CONSTRAINTS IN FORWARD VECTOR-MESON PRODUCTION. Shepard, Harvey K. (Univ. of California, Riverside). Phys. Rev., 168: 1572-8(Apr. 25, 1968).

The behavior near t = 0 of the helicity amplitudes for $\pi N \to VN$, $\pi\pi \to VV$, and $NN \to NN$ is determined, which is consistent with (1) the t = 0 kinematic constraints (conspiracy relations), (2) the classification of Regge poles into O(3,1) families at t = 0, and (3) the requirement of factorization for individual poles of definite quantum numbers. It is shown that from the t dependence thus determined, the rule for the energy dependence of forward scattering amplitudes proposed by Sawyer can be derived. (auth)

26641 PION DECAY OF MESONS IN THE BARYON–ANTI-BARYON MODEL. Davidson, M. G. (Australian National Univ., Canberra). Ann. Phys. (N. Y.), 46: 12-40(Jan. 1968).

The A-parity invariant baryon–antibaryon model is developed in detail and applied to the problem of pion emission of bosons. The problem is split in two parts, charge space and ordinary space. Specific models for bosons are developed and transition matrix elements are calculated in both spaces. The model is specifically applied to transitions between $^1S_0$, $^3S_1$, $^1P_1$, $^3P_0$, $^3P_1$, and $^3P_2$ bosons and compared with experiment. (auth)

26642 Kπ SCATTERING, κ MESON, AND CURRENT ALGEBRA. Roy, Probir (Stanford Linear Accelerator Center, Calif.). Phys. Rev., 168: 1708-11(Apr. 25, 1968). (SLAC-PUB-376).

Kπ scattering is discussed, using a low-energy-dominated sum rule derived from the SU(3) $\otimes$ SU(3) algebra of currents, assuming the pionic and the kaonic pole dominance hypotheses. The exact validity of the latter assumptions implies a much larger S-wave Kπ scattering in the $I = \frac{1}{2}$ channel than in the $I = \frac{3}{2}$ channel. The use of the current-algebra scattering lengths for threshold elastic Kπ scattering suggests that this discrimination is due to a scalar $I = \frac{1}{2}$ resonance. If this is the $\kappa(725)$, a width $\geq 28 \pm 2$ MeV is predicted. If, however, the error in kaonic pole dominance is greater than 30%, the existence of the κ would not be required. (auth)

26643 SCALAR-MESON CANDIDATES FOR TADPOLES. Evans, L. E. (Duke Univ., Durham, N. C.); Fulton, T. Phys. Rev., 168: 1706-7(Apr. 25, 1968).

It is proposed that members of a recently observed scalar octet with particle masses around 1 GeV could play the role of tadpoles. If the anomalous branching ratio of $2\pi/KK$ of the isosinglet member of the octet is accounted for by SU_3 violation, the resulting octet-dominance-violating contribution to the mass formula very much improves the Gell-Mann–Okubo mass relations for pseudoscalar mesons. (auth)

26644 NUCLEON–ANTINUCLEON POTENTIAL FROM SINGLE-MESON EXCHANGES. Bryan, R. A. (Lawrence Radiation Lab., Livermore, Calif.); Phillips, R. J. N. Nucl. Phys., B5: 201-19(1968).

The static and non-static Bryan-Scott potentials, which are based on one-boson-exchange and fit nucleon-nucleon scattering, are adapted to the nucleon-antinucleon system. Terms corresponding to odd-G exchanges are reversed in sign, and an empirical absorptive potential is added. Satisfactory fits to nucleon-antinucleon data are achieved, in the 0-300 MeV range. (auth)

26645 REGGE TRAJECTORIES FOR ISOSPIN-ONE MESONS. Vandermeulen, J. (Univ., Liege). Nucl. Phys., B5: 325-30(1968).

A classification of isospin-one mesons on five linear trajectories with approximately the same slope is proposed. All the mesons observed by missing-mass spectrometer measurements in the 1.6–2.4 GeV range are included and some identifications with bubble chamber peaks are made. Three mesons are predicted in the 2.2 GeV region and their possible connection with structures in the $N\bar{N}$ total cross section is discussed. The question of the narrow widths of the heavier mesons is examined semi-quantitatively; the probable leading decay modes are briefly discussed. (auth)

26646 DYNAMICAL MODEL OF A CONSPIRING PION. Sugar, R.; Blankenbecler, R. (Univ. of California, Santa Barbara). Phys. Rev. Lett., 20: 1014-16(Apr. 29, 1968).

A model for the conspiring pion is presented. Although it is not advocated that the details of the model be taken seriously, nevertheless the structure of the final equations is characteristic of a large class of such models and may be physically relevant. It is assumed that the pion is predominantly a bound state of the nucleon–antinucleon pair. The $\pi-\rho$ channel or any other channel with the appropriate quantum numbers could be added at the expense of simplicity. The starting point is the Feynman-diagram model of Regge poles. The primary concern is the special features which arise because of the rapidly changing character of the pion trajectory in the neighborhood of t = 0. (J.F.P.)

26647 LOWER BOUNDS ON PION–PION AND PION–NUCLEON AMPLITUDES FROM CROSSED-CHANNEL UNITARITY. Roy, S. M. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. Lett., 20: 1016-19(Apr. 29, 1968).

It is shown that using some of the main results of Froissart, Martin, and Jin and Martin (who established a large number of useful bounds on scattering amplitudes by rigorous use of crossing, unitarity, and known dispersion relations) together with the Froissart–Gribov definition of the partial-wave amplitude a (J,t) unitary in the crossed channel, lower bounds are derived on the partial-wave amplitudes for $0 \leq t \leq 4m_\pi^2$, for real values of J, not necessarily integral or half-integral, such that the Froissart–Gribov integral converges. Explicit expressions for the bounds involving the various $\pi\pi \to \pi\pi$, and the $\pi\pi \to N\bar{N}$, and $\pi N \to \pi N$ amplitudes are derived. Numerical values for the lower bounds on the $\pi\pi \to N\bar{N}$ partial-wave amplitudes at t = 0 in the two isospin states are obtained using the pion–nucleon scattering total cross section data. (J.F.P.)

26648 FORWARD DISPERSION RELATIONS AND $\pi-\pi$ SCATTERING LENGTHS. Antoniou, N. G.; Palev, C. (International Atomic Energy Agency, Trieste, Italy). Phys. Lett., 26B: 301-4 (Feb. 5, 1968). (IC-67/79).

The $\pi-\pi$ scattering lengths are evaluated using forward dispersion relations for the $\pi-\pi$ scattering amplitudes. It is assumed that at high energies the forward amplitudes become purely imaginary and that at low energies the T = 0 interaction is much stronger than the T = 2 interaction. It is also assumed that the T = 0 forward amplitude has a low-energy subthreshold zero ($0 < s_0 < 4$). The following values are found for the scattering lengths: $0 < \alpha_0 < 0.14$ (m_π^{-1}), $-0.08 < \alpha_1 < -0.03$ (m_π^{-1}, and $\alpha_1 = 0.044$ (m_π^{-3}) for the T = 0, 2, 1 isospin states respectively. The results are compared with the predictions of other models and especially with the results of current algebra calculations. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 26640, 26647, 26790, 26794, 27281, 27283–27287, 27290, 27310, 27312, and 27391.

26649 (JINR-P2-3590, pp 158-68) O VOZMOZHNOSTI POLUCHENIYA EKSPERIMENTAL'NOI INFORMATSII OV ASIMPTOTICHESKOM POVEDENII "EFFEKTIVNYKH PROSTRANSTVENNO-VREMENNYKH OVLASTEI VZAIMODEISTVIYA CHASTITS." (Possibilities of Obtaining Experimental Information on the Asymptotic Behavior of "Effective Space–Time Domains of Particle Interaction"). Lomsadze, Yu.; Tokar, S. (Uzhgorod State Univ. (Ukrainian SSR)). (In Russian).

26650 (NP-17430) DIPS IN THE C = −1 EXCHANGE CONTRIBUTION OF TWO-BODY INELASTIC PROCESSES. II. KN → K*N AND B-CONSPIRACY. Contogouris, A. P.; Van, J. Tran Thanh (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies); Lubatti, H. J. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Jan. 1968. 13p. Dep.

The Regge theory predictions on the momentum transfer dependence are studied for a specific combination of KN → $K\pi_{8c}N$ differential cross sections which isolates the C = −1 exchange contribution. A way to obtain information on the B-exchange is presented and a forward dip, which is actually observed, in connection with a possible B-conspiracy (of type II or III in the classification of the group O(4)) is discussed. (auth)

26651 (UCRL-18154) N* STUDIES VIA πp INELASTIC REACTIONS. Rosenfeld, Arthur H.; Soeding, Paul H. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 29, 1968. Contract W-7405-eng-48. 47p. (CONF-671203-6). Dep. CFSTI.

From Conference on pi N Scattering, Irvine, Calif.

A brief survey is given of inelastic cross sections and experiments in πp interactions. A summary is given of additional information obtained thus far from the inelastic final states of N* resonances when they are formed in the s-channel $\pi p \to N^* \to \pi\pi N$, ηN, KA, ... Finally, information on branching ratios and signs of amplitudes expected from additional studies, and their relation to SU(3) classification is discussed. (L.B.S.)

26652 COMMENTS ON $\pi\pi$ PHASE SHIFTS AS DETERMINED FROM THE PERIPHERAL MODEL. Bander, Myron (Univ. of California, Irvine); Shaw, Gordon L.; Fulco, Jose R. Phys. Rev., 168: 1679-83(Apr. 25, 1968).

The determination of the S-wave $\pi\pi$ phase shifts δ_0^I at low energy from the analysis of $\pi N \to (2\pi)N$ is examined critically from the standpoint of the one-pion-exchange model with absorptive corrections. It is found that: (1) The value of δ_0^I depends strongly on the P-wave phase shifts, which cannot be unambiguously determined, at $m_{\pi\pi} < 600$ MeV, by using a Breit-Wigner formula. (2) The ratio of the production density matrix elements ρ (with the $\pi\pi$ elastic scattering amplitudes factored out) depends strongly on $m_{\pi\pi}$ for $m_{\pi\pi} < 600$ MeV. (3) The $(F - B)/(F + B)$ asymmetry shows a sizeable dependence on the momentum transfer t to the nucleon. It is concluded that more accurate data at low $m_{\pi\pi}$ are required in order to determine δ_0^I for $m_{\pi\pi} < 600$ MeV. Tables of the $\rho(m_{\pi\pi},t)$ calculated from the absorption model for an incident-pion laboratory kinetic energy of 4 BeV are included. These could be directly applied to the data to obtain the low-energy $\pi\pi$ phase shifts. (auth)

26653 MODEL OF POSITIVE-PARITY BARYON EXCITED STATES. Golowich, E. (Carnegie-Mellon Univ., Pittsburgh, Univ. of Massachusetts, Amherst). Phys. Rev., 168: 1745-52 (Apr. 25, 1968).

The occurrence in nature of very high-spin baryons leads to the suggestion that they can be described as composites of high-spin baryons and mesons with low orbital angular momentum. As a consequence, there appears to be no limit beyond which the baryon spectrum cannot extend. These ideas are implemented with a dynamical bootstrap model of positive-parity baryons employing $SU(2) \times O(3)$ symmetry. The consistency of this symmetry with the dynamics is proved, and a spectrum is predicted in accord with the latest phase-shift analysis of the pion-nucleon system. It is indicated how the model is described in a Regge theory of angular momentum trajectories. A comment is made on the negative-parity baryon spectrum. (auth)

26654 NEW πN SUPERCONVERGENT SUM RULES AND DETERMINATION OF P′-TRAJECTORY PARAMETERS. Liu, Yu-chien; Okubo, S. (Univ. of Rochester, N. Y.). Phys. Rev., 168: 1712-14(Apr. 25, 1968). (UR-875-225).

New superconvergent dispersion relations for the forward, crossing-even πN scattering amplitude were derived and compared with experiment. The essential point is the assumption of dominant Regge behavior at high energy and the inclusion of the real part of the scattering amplitude. Sum rules for the P and P′ residues involving only experimentally accessible quantities are computed, using data of Höler and Lindenbaum. The Regge P′ parameters are found as $\alpha_{P'} \approx 0.39$, $\gamma_{P'} \approx 1.82\mu^{-1}$. (auth)

26655 s-WAVE QUARKS AND BARYON RESONANCES. Mitra, A. N. (Univ. of Delhi); Katyal, D. L. Nucl. Phys., B5: 308-16(1968).

An s-wave model of quark-quark forces is examined in detail in the context of a three-quark treatment of baryons and their resonances using parastatistics. The model, which is an extension of one proposed recently by one of the authors (A. N. M.), gives attractive kernels for $\{56\}$, $(\text{even})^+$ and $\{70\}$, $(\text{odd})^-$ states in an SU(6), L^P classification, in agreement with Dalitz's classification of such states up to the first few L-excitations. An energy formula is also obtained of the type $E_L = \bar{E} - \text{const}\ \eta^L$ ($\eta < 1$), leading to an "ionization energy" $\bar{E}$ for a quark-diquark system. The theoretical and experimental implications of these results are discussed. (auth)

26656 NEW SUPERCONVERGENT DISPERSION RELATIONS FOR THE FORWARD πN CROSSING-EVEN AMPLITUDE. George, David J.; Hale, Barbara; Tubis, Arnold (Purdue Univ., Lafayette, Ind.). Phys. Rev., 168: 1924-5(Apr. 25, 1968). (COO-1428-42).

A Liu-Okubo-type dispersion relation is derived for the crossing-even pion-nucleon forward elastic scattering amplitude $T^{(+)}$. Two subtractions are made, one at the physical scattering threshold and the other at a previously determined zero of $T^{(+)}$ on the imaginary axis of the complex ω (pion lab energy) plane. The dispersion relation is well satisfied over the whole allowed range of the Liu-Okubo parameter. Moreover, it is nearly saturated by low-energy scattering for a considerable range of the parameter. It should thus serve as an extremely sensitive test of the low-energy scattering data when such data become more accurately known. (auth)

26657 INVESTIGATION OF THE PION TRAJECTORY IN A REGGE-POLE MODEL. Haber, B. (Weizmann Inst. of Science, Rehovoth, Israel); Maor, U.; Yekutieli, G.; Gotsman, E. Phys. Rev., 168: 1773-9(Apr. 25, 1968).

Reactions of π, K, $\bar{p}$, and p resulting in $\Delta(1238)$ production are examined. It is shown that whenever an exchange with $P = (-)^{J+1}$ is allowed by the known selection rules, this exchange dominates the production mechanism at small momentum transfers. This phenomenon is described in terms of a Regge-pole model for pion exchange. Arguments are given to show that although the pion trajectory is lower than the ρ and A_2 trajectories, π exchange can dominate at small $|t|$ values. The pion trajectory is determined from the experimental data, and fits for the differential cross sections at various energies are given for $|t| \leq 0.25\ (\text{GeV/c})^2$. (auth)

26658 APPLICATION OF A UNITARY IMPULSE APPROXIMATION TO PION-NUCLEON SCATTERING. Finkel, Robert W. (St. John's Univ., Jamaica, N. Y.); Rosenberg, Leonard. Phys. Rev., 168: 1841-4(Apr. 25, 1968).

A unitary impulse approximation given previously is described here in a more general (multichannel) form. To test the method, it is applied to a soluble model of K^--d scattering and encouraging results are obtained. The method is then applied to π-N elastic scattering. Good agreement with the experimentally determined d_{13} amplitude is obtained for energies near the second resonance. While the impulse approximation violates unitarity bounds, the unitary impulse approximation shows no such violations. (auth)

26659 FACTORIZATION, ω CROSSOVER, POLARIZATION, AND FINITE-ENERGY SUM RULES FOR KAON-NUCLEON SCATTERING. Dass, Guru Vachan (Atomic Energy Research Establishment, Harwell, Eng.); Michael, C. Phys. Rev. Lett., 20: 1066-9(May 6, 1968).

KN finite-energy sum rules, with phase-shift analyses as input, are evaluated to determine the t dependence of the relevant Regge-exchange amplitudes. The spin nonflip contributions are similar to those deduced from high-energy Regge fits; however, the spin-flip contributions of the high-energy fits are inconsistent with the sum-rule results. The implications for polarization and K^+n charge exchange are discussed. (auth)

26660 DOLEN-HORN-SCHMID DUALITY AND THE DECK EFFECT. Chew, G. F.; Pignotti, A. (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev. Lett., 20: 1078-81(May 6, 1968). (UCRL-18124).

An extension to multipheralism is made of the Dolen-Horn-Schmid duality argument relating Regge poles to low-energy resonances. The Deck model is thereby interpreted as predicting the existence of the A_1, rather than as undermining experimental evidence for this resonance. It is shown in general that Dolen-Horn-Schmid duality permits a vast simplification in the calculation of multiple-production processes. (auth)

26661 SEMICLASSICAL THEORY OF π MESON SCATTERING ON NUCLEONS IN THE CASE OF TIGHT COUPLING. Izmailov, S. V.; Smirnov, A. I.; (Leningrad Pedagogical Inst.). Izv. Vyss. Ucheb. Zaved., Fiz., No. 11, 107-11(1967). (In Russian).

The scattering cross sections of the reactions $\pi + N \to N + \pi$, $\pi + N \to N + \rho$ were calculated by the semiclassical method. It was predicted that the final reaction proceeds by the N^{**} resonance. The mass, spin, and isotopy of this resonance was predicted. The zero approximation on the coupling constant between π and ρ mesons was examined. (tr-auth)

26662 POSSIBLE EVIDENCE FOR THE $N\pi\pi$ DECAY MODE OF THE $\Delta(1920)$ AND THE $\Delta(2420)$ NUCLEON ISOBARS. Galloway, K. F. (Indiana Univ., Bloomington). Phys. Lett., 26B: 334-5(Feb. 5, 1968).

When the cross section for the $\pi^+p \to \pi^+\pi^+n$ reaction is plotted versus total center of momentum energy, there is structure suggesting the $N\pi\pi$ decay mode of the $\Delta(1920)$ and the $\Delta(2420)$. Estimates of the branching fractions into $n\pi^+\pi^+$ are made. (auth)

26663 COHERENT PRODUCTION AND DECK-EFFECT ON DEUTERONS. De Groot, E. H.; Wolters, G. F. (Univ., Amsterdam). Phys. Lett., 26B: 636-9(Apr. 15, 1968).

Reliability of predicted kinematical enhancements is discussed. Calculations for coherent deuterium reactions are compared with experiment. (auth)

26664 VECTOR MESON DOMINANCE ANALYSIS OF DATA ON THE REACTION $\pi^- + p \to \rho^0 + n$. Krammer, Margarete (Deutsches Elektronen-Synchrotron, Hamburg). Phys. Lett., 26B: 633-5(Apr. 15, 1968).

The data on the reactions $\gamma p \to \pi^+ n$ and $\pi^- p \to \rho^0 n$ are compared. The vector meson dominance relation is found to be satisfied at small momentum transfers. There are discrepancies for higher $|t|$ and at the maximum energy investigated. (auth)

26665 ON THE DECOUPLING OF A SECOND ρ IN FORWARD πN SCATTERING. Olsson, M. G. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Lett., 26B: 310-12(Feb. 5, 1968). (COO-881-150).

A general sum rule is used to provide accurate information about the Regge ρ parameters in the forward direction. When combined with high energy data an upper limit for a ρ' pole is placed at one-tenth the strength of the ρ pole. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 26640.

26666 (JINR-P2-3778) POLYARIZATSIONNYE EFFEKTY PRI UPRUGOM Nd-RASSEYANII V PRIBLIZHENII GLAUBERA. (Polarization Effects of the Nd Elastic Scattering in the Glauber Approximation). Tseren, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 14p. (In Russian). Dep.

The dependence of the total cross section of the Nd-elastic scattering was considered in the Glauber approximation. The expression for the double scattering amplitude was obtained. It is written after the summation of three diagrams. By means of this expression one may calculate the σ_{tot}-total cross section of Nd-interaction and the $(d\sigma/d\Omega)(0)$-cross section of the Nd-elastic scattering. Using the optical theorem $[\sigma_{tot} = (k/4\pi)\,\mathrm{Im}Sp\,(\rho F(0)]$, where ρ is the spin matrix density) one obtains the expression for the contribution, due to the double collision of a particle with nucleons in the deuteron, to the impulse approximation. In this case the main contribution of the amplitude in the zero angle neighborhood may be written behind the integral sign. In the case of πd-scattering a series expansion was made. The numerical estimate obtained in the energy range of 66–630 MeV shows that the correction due to the double collision equals on the average 9–10% with respect to impulse approximation. (auth)

26667 (LYCEN-6801) LIAISONS ENTRE LES PHENOMENES DE HAUTE ET BASSE ENERGIES DANS LA DIFFUSION ELASTIQUE NUCLEON-NUCLEON. (Relations Between High-and Low-Energy Phenomena in Nucleon-Nucleon Elastic Scattering). Thevenet, Christiane (Lyon Univ. (France). Institut de Physique Nucleaire). Jan. 11, 1968. 68p. (In French). Dep.

Thesis.

The introduction of the hard core in the Born approximation of the amplitudes of the meson exchanges is avoided by inserting in the calculation of the Born terms form factors which take into consideration experimental results on nucleon-nucleon scattering at high energy. Two expressions for these form factors are proposed and the literal expressions of the corresponding potentials were calculated for each of them. An adjustment with the experimental data (of high and low energy) makes it possible to determine the parameters introduced in the form factor. (tr-auth)

26668 REMARKS ON PARTICLE-NUCLEUS SCATTERING. Chou, T. T. (State Univ. of New York, Stony Brook). Contract AT(30-1)-3668B. Phys. Rev., 168: 1594-7(Apr. 25, 1968).

The differential cross section of elastic p-He^4 scattering at 1.7 BeV/c is computed, using a nuclear wave function consistent with elastic eα scattering data. A calculation of the elastic scattering cross section for π^--He^4 at 8 BeV/c is also presented. (auth)

26669 ON THE SOLUTION OF AN EQUATION FOR SINGLET $^1S_0$-WAVE OF PP-SCATTERING. Lendyel, V. I.; Tovtin, E. V. (Uzhgorod Univ., Kiev). Nucl. Phys., B5: 346-54(1968).

An approximate analytical solution to the $^1S_0$-wave equation of pp scattering is obtained. This approximate solution gives a good description of the experimental data. A comparison of this solution with the results obtained by numerical methods is carried out. (auth)

26670 SECOND-CLASS CURRENTS AND THE WEAK NUCLEON-NUCLEON INTERACTION. Blin-Stoyle, R. J.; Herczeg, P. (Univ. of Sussex, Brighton, Eng.). Nucl. Phys., B5: 291-307(1968).

The effect of second-class currents on the form of the weak internucleon potential is investigated in time-reversal invariant and time-reversal non-invariant theories. (auth)

26671 REMARKS ON p–p ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFERS. Etim, E.; Greco, M. (CNEN, Rome). Phys. Lett., 26B: 313-14(Feb. 5, 1968).

An attempt is made to determine whether the experimental data on p–p elastic scattering at large momentum transfers obtained previously definitely rules out the Orear formula. For this purpose $\lg(d\sigma/dt)_{cm}$ as given by the Orear formula is plotted against $s\sin\theta_{cm}$, for $\theta_{cm} \approx 90°$ (s is $\sin\theta_{cm} \approx s$). It is found that for $\theta \approx 90°$ and for large momentum transfers the Orear formula is able to reproduce quite well all experimental data, and no kinks are therefore suggested as being present, for $\theta \approx 90°$, in the plot of $\lg(d\sigma/dt)_{cm}$ against $s\sin\theta_{cm} \approx s$. From these results an attempt is made by means of a suitable stitch to the Orear formula, to fit experimental data at all angles available. It is found that the derived formula is able to reproduce all experimental data. As a result of the good fits it is concluded that an exponential dependence of the form $\exp(-bs\sin\theta)$ cannot be seriously maintained, and that there are no first-order discontinuities in the cross sections. (J.F.P.)

Particle Invariance Principles and Symmetries

Refer also to abstract 27382.

General

26672 (ITF-67-34) O NEPRIVODIMOSTI BESKONECHNOMERNYKH PREDSTAVLENII ALGEBRY LI GRUPPY VRASHCHENII R_3. (On Irreducibility of Infinite Dimensional Representations of the Lie Algebra of the Rotation Group R_3). Sannikov, S. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 10p. (In Russian). Dep.

The proof is given of the algebraic and topological irreducibility of the discrete and continuous series of infinite dimensional representations of the Lie algebra for the rotation group R_3. The topological irreducibility is stated in countable-normed spaces of exponential type. (auth)

26673 (ITF-67-35) O RIMANOVYKH POVERKHNOSTYAKH ANALITICHESKIKH GRUPP LI I PROSTRANSTVAKH FUNKTSII NA NIKH. (On Riemann Surfaces of Analytical Lie Groups and Functional Spaces on Them). Sannikov, S. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 10p. (In Russian). Dep.

The topological structure of the group space of many-valued analytical functions on the compact simply connected Lie group G is studied. The notion of Riemann surface is introduced as a covering manifold of the analyticity domain of many-valued functions on G. The construction of the class of test functions Φ and distributions Φ' on G, occurring in the theory of infinite-dimensional representations of compact Lie groups are presented. The basic properties of mapping $g \to T(g)$, gEG in Φ' are stated. (auth)

26674 (JINR-P2-3590, pp 198-200) EXTENDED CONFORM INVARIANT MODEL OF FREE ELEMENTARY PARTICLES. Vigier, Jean-Pierre (Paris Univ. (France). Institut Henri Poincare).

The problem of the possible existence of a global dynamical group containing both internal (such as SU(3) or SU(2,1)) and external (such as $\bar{P} \times U(1)$ or $SO(4,1) \times U(1)$) symmetries is discussed briefly. (J.F.P.)

26675 (JINR-P2-3725) NELINEINYE PREDSTAVLENIYA GRUPPY LI. (Nonlinear Representations of the Lie Group). Stoyanov, D. Ts.; Khristov, Kh. Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 21p. (In Russian). Dep.

The basic determinations and theorems of the theory of the continuous Lie groups, expressed in terms of nonlinear representations of these groups, are reviewed. This means that the basic theorems of this theory are reformulated in such a way that it is possible to classify all the possible realizations (not only linear) of the given Lie group G using these theorems. (auth)

26676 SU(3) CROSSING MATRIX. Sharp, R. T. (Univ. of Illinois, Urbana). Phys. Rev., 168: 1753-5(Apr. 25, 1968).

The SU(3) crossing matrix is given in a simplified form and is related to the more symmetric 6pq symbol. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 26213.

26677 SU(3) SYMMETRY-BREAKING INTERACTIONS. Tanaka, K. (Ohio State Univ., Columbus). Phys. Rev., 168: 1633-7(Apr. 25, 1968). (COO-1545-27).

It is proposed that all symmetry-breaking interactions H^1 are of the current–current form, and a calculational method suitable for obtaining sum rules is developed. The method essentially is to express the matrix elements of H^1 in terms of the matrix elements of the double commutator of H^1 with SU(3) generators. When the method is combined with the technique of reducing a pion, it can be shown that the S-wave amplitudes of both the triangle relation and the Lee-Sugawara relation of nonleptonic decays correspond

to sum rules of photonic decay amplitudes and semileptonic decay amplitudes of hyperons. (auth)

26678 NONLEPTONIC FOUR-FERMION $\Delta = 1$ INTERACTIONS, SU_3 SYMMETRY, AND THE RP INVARIANCE. Radutskii, G. M.; Tabachenko, A. N.; Filimonov, V. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 11, 78-85(1967). (In Russian)

The result of the assumption that the Lagrangian of the weak interaction of hadrons has a transforming property of the components of the octet and RP invariants, was found to be the relation between the amplitude of the four-fermion nonleptonic interaction with $\Delta S = 1$. Knowledge on this interaction can be obtained from nonmeson decays of different forms of the hypernucleus. (tr-auth)

Applications (Strong)

26679 (NP-17357) SIMETRIA SU_3 E INTERACCIONES REALISTAS. (SU_3 Symmetry and Realistic Interactions). Perez Pascual, Rafael (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1967. 51p. (In Spanish). Dep.

Thesis.

In order to construct the matrix elements of an arbitrary reaction, kets classified by the Wigner supermultiplet theory and the SU_3 scheme are used. The form of the quantum numbers for the classification according to the group chain is given. The kets classified for this chain are then calculated. The method for the calculation of the matrix elements of V interaction between particle pairs is given. The method is applied to the nuclei ^{18}F, ^{18}O, ^{20}Ne, and ^{20}O by using very effective potentials derived from the Hamada–Johnston potential. The results obtained are shown graphically. (J.S.R.)

26680 REPRESENTATIONS OF THE STRONG-COUPLING GROUP OF PSEUDOSCALAR-MESON THEORY AND THE PROCEDURE OF CONTRACTION. Vaidya, S. M. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 168: 1578-9 (Apr. 25, 1968).

A physically interesting isobar series for the group of the strong-coupling theory $[SU(2) \otimes SU(3)] \times T_{24}$ was obtained by Goebel and others by using the method of the induced representation. It is shown that the procedure of contraction on SU(9) leads in a very simple way to the same isobar series. (auth)

26681 THE DYNAMICAL GROUP OF THE SU(3)-SYMMETRIC STRONG COUPLING THEORY. Bednar, M. (Inst. of Physics, Prague); Tolar, J. Nucl. Phys., B5: 255-76(1968).

Starting from the Hamiltonians, the complete infinite sets of isobaric states for two SU(3)-symmetric strong coupling models (with scalar and pseudo-scalar mesons) are determined using the idea of the dynamical group. The physically meaningful unitary irreducible representations of the dynamical groups $SU(3) \cdot T_8$ and $[SU(3) \otimes SU(2)] \cdot T_{24}$ follow from the minimization requirement on the potential energy part of the Hamiltonians in the strong coupling limit. The composition of these infinite dimensional representations in terms of representations of the symmetry groups SU(3) and $SU(3) \otimes SU(2)$ has been obtained. (auth)

26682 EVIDENCE FOR O(4,2), ASSIGNMENT OF HADRON LEVELS. Barut, A. O. (Univ. of Colorado, Boulder). Phys. Lett., 26B: 308-9(Feb. 5, 1968).

Due to the fact that the phase shift analysis does not give a unique solution and that one could, in principle, obtain an entirely new set of resonances, it is important to discuss the place of these new resonances in the theoretical framework and to make predictions so that a unique solution of the phase shift analysis may be obtained. The possible $|njm \pm)$ assignments of the $I = 1/2$ and $I = 3/2$ baryon levels are shown. (J.F.P.)

Field Theories

Refer also to abstract 26112.

Quantum Field Theory

Refer also to abstract 26538.

26683 (ITF-67-36) TEORIYA VOZMUSHCHENII DLYA KALIBROVOCHNO-INVARIANTNYKH POLEI. (Perturbation Theory for Gauge-Invariant Fields). Popov, V. N.; Faddeev, L. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 28p. (In Russian). Dep.

A method is developed for the manifestly covariant quantization of gauge-invariant fields by means of a functional integration. It is shown that for the fields with a non-Abelian gauge groups (the Yang-Mills and gravitational fields) the fictitious particles appear naturally in the diagram technique, which are not present in the initial Lagrangian. An appearance of these particles restores the transversality of scattering amplitudes and the unitarity of the S-matrix. (auth)

26684 (JINR-P2-3727) METOD POSTROENIYA FUNKTSII GRINA V IMPUL'SNOM PROSTRANSTVE DLYA NEPERENORMIRUEMYKH VZAIMODEISTVII. (A Method of Construction of the Green Functions in the Momentum Space for Unrenormalizable Interactions). Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 25p. (In Russian). Dep.

A unitary procedure of construction of the Fourier-transform of the two-point Green functions in the local and nonlocal theories with the unrenormalizable interactions is developed. Spectral representations of these functions were found. It is shown that the functions investigated have logarithmic branch point with respect to g^2 at $g^2 = 0$ in the momentum space. (auth)

26685 (JINR-P2-3739) O NORMAL'NOI FORME OPERATOROV V PROSTRANSTVE FOKA. (On the Normal Form of Operators in the Fock Space). Oksak, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 29p. (In Russian). Dep.

Some classes of unbounded operators in the second quantization space which can be reduced to normal form are pointed out. The possibility of such reduction is associated closely with the domains of operators and their adjoint. It is shown in particular that the out-fields of the quantum field theory can be expanded in the in-fields. (auth)

26686 (JINR-P2-3740) SPEKTRAL'NAYA PLOTNOST' CHELLENA-LEMANA. (Kaellen-Lehmann Spectral Density). Oksak, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 9p. (In Russian). Dep.

It is shown that in the framework of Wightman axiomatic field theory with the condition of asymptotic completeness the Källen-Lehmann spectral density $\rho(\lambda)$ given by $\langle A(x)A(y)\rangle_0 = (1/i)\Delta^-_m(x-y) + (1/i)\int_{4m}^{\infty} \Delta^-_\lambda(x-y)\,\rho\,(\lambda)\,d\,\lambda$ is a locally summable function. (The statement is true also for unrenormalizable theories under the asymptotic completeness condition.) The fact that the operators of four momentum P and of effective mass $M = \sqrt{(P)^2}$ in the "in"-particles Fock space are absolutely continuous on the subspace orthogonal to the vacuum and one-particle states was used essentially. (auth)

26687 (JINR-P2-3590) PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON NON-LOCAL QUANTUM FIELD THEORY, DUBNA, JULY 4–7, 1967. (Joint Inst. for Nuclear Research, Dubna (USSR)). 229p. (In English and Russian). (CONF-670726). Dep.

The following types of nonlocality were considered in the 27 papers presented: different types of form factors, modification of geometry, stochastic space, indefinite metric, Hilbert space, nonlocality following from infinite-dimensional symmetry theory, and the connection of nonlocal and unrenormalizable theories. The role of gravitation and nonlinearity was also discussed. (C.E.S.)

For titles of individual papers see: 26574–26577, 26591, 26636, 26637, 26649, 26674, 26688–26702, 26711, 26722, and 26723.

26688 (JINR-P2-3590, pp 11-16) NELOKAL'NAYA KVANTOVAYA TEORIYA POLYA. (Nonlocal Quantum Field Theory). Review Talk. Kirzhnits, D. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). (In Russian).

26689 (JINR-P2-3590, pp 31-7) MAKROPRICHINNOST' V NELOKAL'NOI TEORII POLYA. (Macroscopic Causality in Nonlocal Quantum Field Theory). Sutula, V. D. (Akademiya Nauk SSSR, Novosibirsk. Institut Kataliza). (In Russian).

26690 (JINR-P2-3590, pp 44-5) NONLOCAL THEORIES. Fierz, M. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)).

The development and limitations of nonlocal theories are considered. Quantum electrodynamics, perturbation theory, and field theory are discussed. (J.F.P.)

26691 (JINR-P2-3590, pp 52-4) TEORIYA KVANTOVANNOGO PROSTRANSTVA I SPEKTR MASS ELEMENTARNYKH CHASTITS. (Quantized-Space Theory and the Mass Spectrum of Elementary Particles). Leznov, A. N. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). (In Russian).

26692 (JINR-P2-3590, pp 55-8) GRADIENTNO-INVARIANTNAYA NELOKAL'NAYA KVANTOVAYA ELEKTRODINAMIKA.

(Gauge Invariant Nonlocal Quantum Electrodynamics). Kirzhnits, D. A.; Leznov, A. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki. Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). (In Russian).

26693 (JINR–P2-3590, pp 59-68) NELOKAL'NAYA KVANTOVAYA TEORIYA SKALYARNOGO POLYA. (Nonlocal Quantum Scalar Field Theory). Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). (In Russian).

26694 (JINR–P2-3590, pp 69-74) INDEFINITE METRIC AND NONLOCAL INTERACTION. Duerr, H. P. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)).

The mechanism of the indefinite metric in quantum electrodynamics is briefly demonstrated. Then the theory of a zero-mass, spin-two particle, which is formally related to linearized gravitational theory, is investigated. Finally, the indefinite metric in these cases is compared with the indefinite metric in the Lee model and in Heisenberg's nonlinear spinor theory. It is further indicated how the local, noncanonical spinor theory can be translated into a theory with canonically quantized fields which obey a particular nonlocal interaction. (J.F.P.)

26695 (JINR–P2-3590, pp 75-80) RADICAL REMOVAL OF THE CONVERGENCE DIFFICULTIES. Rayski, Jerzy (Jagellonian Univ., Krakow (Poland)).

A possibility is found of formulating a quantum field theory differing considerably from the traditional one, namely, involving a form factor which depends upon the total energy–momentum of the considered coherent system. In this theory energy and momentum are defined only implicitly. It is shown that it is possible to formulate, in this way, a consistent electrodynamics free of divergences and satisfying the requirements of relativity, macrocausality, and gauge invariance. (J.F.P.)

26696 (JINR–P2-3590, pp 86-91) KVANTOVAYA TEORIYA POLYA V PROSTRANSTVE SLUCHAINYKH KOORDINAT. (Quantum Field Theory in the Space of Random Coordinates). Grigor'ev, V. I. (Moscow State Univ. (USSR)). (In Russian).

26697 (JINR–P2-3590, pp 96-113) ARE UNRENORMALIZABLE INTERACTIONS LOCAL? Guettinger, W. (Munich Univ. (West Germany)).

A new approach to four-fermion and other unrenormalizable interactions is developed and the local properties of these interactions are analyzed. Using generalized function techniques it is shown that unrenormalizable field theories possess perturbative solutions in Minkowski space which are finite in every approximation and do not suffer from an infinite set of renormalization constants. In the case of ladder and string approximations to four-fermion theories this is explicitly demonstrated. The local structure of commutators and anticommutators is analyzed and a condition for locality in case of nontempered spectral functions characteristic for unrenormalizable theories is derived. It is shown that, within the approximations considered, four-fermion theories are local. In spite of these mathematical results, the requirement that bound states exist in four-fermion theories seems to necessitate the introduction of some sort of nonlocality which guarantees the stability of the system. Euclidean techniques, related to peratization, which seem to simulate such a nonlocality in the Bethe-Salpeter case, lead, however, to inconsistent results if applied to propagator equations. (auth)

26698 (JINR–P2-3590, pp 114-26) MODEL'KVANTOVOI TEORII POLYA SO SPEKTRAL'NYMI FUNKTSIYAMI BYSTROGO ROSTA. (Quantum Field Theory Model with Rapidly Increasing Spectral Functions). Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR)). (In Russian).

26699 (JINR–P2-3590, pp 127-36) ASIMPTOTIKA I ANALITICHESKOE PRODOLZHENIE PO KONSTANTE SVYAZI V NEPERENORMIRUEMYKH TEORIYAKH POLYA. (Asymptotics and the Analytic Continuation in the Coupling Constant in Nonrenormalizable Field Theories). Arbuzov, B. A.; Filippov, A. T. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR). Joint Inst. for Nuclear Research, Dubna (USSR)). (In Russian).

26700 (JINR–P2-3590, pp 137-47) OB ODNOI VOZMOZHNOSTI V PROBLEME ZARYADA NUL. (A Possibility in the Zero Charge Problem). Voronov, B. L. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). (In Russian).

26701 (JINR–P2-3590, pp 148-57) LOKAL'NYE I NELOKAL'NYE OBOBSHCHENNYE FUNKTSII. (Local and Nonlocal Generalizations). Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). (In Russian).

26702 (JINR–P2-3590, pp 211-27) POLYA I CHASTITSY. (Fields and Particles). Shirokov, Yu. M. (Akademiya Nauk SSSR, Moscow. Matematicheskii Institut). (In Russian).

26703 FIELD-CURRENT IDENTITIES AND INTERMEDIATE BOSONS. Lee, T. D. (Columbia Univ., New York). Phys. Rev., 168: 1714-27(Apr. 25, 1968). (NYO–1932(2)-129).

The observed total weak-interaction current $I_\mu^{wk}(x)$ and the observed total electromagnetic current $I_\mu^{y}(x)$ are assumed to be, respectively, the same local operators, apart from constant multiplicative factors, as the hypothetical charged intermediate boson field $W_\mu(x)$ and the corresponding neutral intermediate boson field $W_\mu^0(x)$. The field algebra satisfied by these current operators is discussed. It is shown that, neglecting higher-order weak-interaction effects, finite higher-order electromagnetic corrections can be obtained for the known hadrons and leptons, such as the electromagnetic mass shifts of p, π, e, μ, etc., and the radiative corrections to the weak decays of these particles. (auth)

26704 QUANTUM THEORY OF FIELD ATTENUATION. Mollow, B. R. (Brandeis Univ., Waltham, Mass.). Phys. Rev., 168: 1896-1919(Apr. 25, 1968).

A quantum-mechanical theory of photon detection is presented which takes fully into account the attenuation of the field due to the detection process. The time evolution of the joint quantum state of the detector and the field is found, to all orders in perturbation theory. Formulas are derived for the probabilities of absorbing specified numbers of photons within a given time interval, and for the correlations in the positions and times at which absorptions take place. The results are free from the inconsistencies which arise in the conventional theory of photon detection, and remain valid even when the field becomes appreciably attenuated during the experiment. It is found that an initially coherent field state remains coherent during its interaction with a given detector, and that its amplitude becomes attenuated by an amount which is completely independent of the number of counts which the detector records. This independence is shown to be a simple consequence of the Poisson quantum-number distribution of coherent fields. The counting statistics for arbitrary fields are expressed in a way which shows explicitly the relationship between the attenuation of the field and the absorption of quanta by the detector. The analysis is performed by first treating the case in which the field is confined within a homogeneous detecting medium throughout the experiment, and then generalizing to the case in which the field spends a limited amount of time in a spatially localized detecting region. The detector is assumed to consist of harmonic oscillators, which are shown to represent a suitable formal model for the absorption of radiation by large numbers of conventional detecting atoms. (auth)

26705 DAUGHTER TRAJECTORIES IN THE WICK–CUTKOSKY MODEL OF THE BETHE–SALPETER EQUATION. Mueller, H. J. W. (Univ., Munich). Nucl. Phys., B5: 277-90 (1968).

A low-energy perturbation method is used for solving the Bethe-Salpeter equation of the Wick-Cutkosky model in the case of unequal masses. Explicit expansions are obtained for both the solutions and eigenvalues, thus enabling a direct and analytic discussion of Regge daughter trajectories. The expansions are effectively double expansions in the total energy and the mass-difference of the scattered particles. (auth)

26706 FREE MASSLESS FIELDS AS INFINITE-DIMENSIONAL REPRESENTATIONS OF THE LORENTZ GROUP. Bender, Carl M. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 168: 1809-16(Apr. 25, 1968).

Free quantized massless field theories of arbitrary spin L are investigated. The transverse potential in the radiation gauge is shown to transform as a nonunitary infinite-dimensional representation of the Lorentz group: $(L,1) \oplus (L,-1)$ for integer spin and $(L+\frac{1}{2}, \frac{1}{2}) \oplus (L+\frac{1}{2}, -\frac{1}{2})$ for integer $+\frac{1}{2}$ spin (Gel'fand and Shapiro's notation). Using Lorentz group theory, it is argued that free quantized massless field theories of spin >1 do not possess a stress-energy tensor $T^{\mu\nu}$. (auth)

26707 FEYNMAN RULES FOR REGGEONS. Fronsdal, C. (International Atomic Energy Agency, Trieste, Italy). Phys. Rev., 168: 1845-54(Apr. 25, 1968). (IC–67/70).

Rules are formulated for the evaluation of Feynman diagrams in which the virtual lines represent infinite multiplets with discrete and/or continuous spectra. In the simplest case this is a theory of Reggeon Feynman diagrams. The fact that infinite multiplets can represent multiparticle states with continuous mass spectra is emphasized, and a special case of "Compton" scattering via two-particle intermediary states is studied in detail. The kinematical structure of the amplitudes is fixed by the vertices, and is physically reasonable in all channels, particularly near $u = 0$ in unequal-mass scattering. This allows a particularly convenient empirical representation of the dynamics. It should be emphasized that the mass spectra of the infinite

multiplets are perfectly general, and that no higher symmetry is implied. (auth)

26708 HERMITICITY OR NON-HERMITICITY OF THE HAMILTONIAN FOR AN UNSTABLE PARTICLE IN QUANTUM FIELD THEORY. Nguyen Van Hien (Faculte des Sciences, Paris). Compt. Rend., Ser. A and B, 266: 175-7(Jan. 15, 1968). (In French).

A model of the quantum field theory is studied in which the scattering amplitude extended analytically in the second Riemann shell has a complex pole that can be interpreted as an unstable particle. It is shown that the Hamiltonian is hermitian in the first Riemann shell and that it is not in the second because of the characteristic bivalence at the values taken by it. (tr-auth)

26709 S-MATRIX IN SEMICLASSICAL APPROXIMATION. Nambu, Y. (Univ. of Chicago). Contract AT(11-1)-264. Phys. Lett., 26B: 626-9(Apr. 15, 1968). (COO-264-422).

It is shown that the tree approximation currently utilized in connection with phenomenological chiral Lagrangians corresponds to a semiclassical approximation applied to the S-matrix in quantum field theory. Some invariance properties of the S-matrix are derived in this framework. (auth)

26710 ADVANCED QUANTUM MECHANICS. Sakurai, J. J. Addison-Wesley Series in Advanced Physics. Reading, Mass., Addison-Wesley Publishing Company, 1967. 336p.

The major advances in the fundamentals of quantum physics from 1927 to the present are presented. The emphasis is primarily on the quantum theory of radiation, the Dirac theory of leptons, and covariant quantum electrodynamics. Also classical fields, relativistic quantum mechanics of spin-$\frac{1}{2}$ particles, and covariant perturbation theory are covered. (J.F.P.)

Gravitation and General Relativity

Refer also to abstracts 26150 and 26536.

26711 (JINR-P2-3590, pp 201-10) ON THE EFFECT OF DICKE AND THE MULTITEMPORAL THEORY OF RELATIVITY. Kalitzin, Nikola St. (Bulgarian Academy of Sciences, Sofia. Inst. of Physics).

It is shown that the advance of the perihelion of Mercury is obtained in the multitemporal theory of relativity by multiplying Einstein's value for the advance of the perihelion by the factor $(1 + \alpha)$. If one assumes $\alpha = -0.09$, then for Mercury the centennial advance of the perihelion is found to be 39.13 seconds. This value is in agreement with the motion of the perihelion calculated by Dicke after subtracting the 4 seconds, which according to Dicke are due to the flattening of the sun, from the 43 seconds. (J.F.P.)

26712 STABLE STATES OF A SCALAR PARTICLE IN ITS OWN GRAVITATIONAL FIELD. Feinblum, David A. (State Univ. of New York, Albany); McKinley, William A. Phys. Rev., 168: 1445-50(Apr. 25, 1968).

Structures similar to classical geons are constructed using a matter field described by the Klein-Gordon equation. The matter field creates a gravitational field which interacts with the matter. The coupled system has stable, bound states. A spectrum of states is shown to exist with masses of the order of 10^{-10} kg. A variational principle is derived which is in precise analogy with the Rayleigh-Ritz principle of conventional quantum mechanics. (auth)

26713 HARMONIC AND NULL DESCRIPTIONS OF GRAVITATIONAL RADIATION. Isaacson, Richard A.; Winicour, Jeffrey (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Phys. Rev., 168: 1451-6(Apr. 25, 1968).

An axially symmetric space-time containing gravitational waves is first considered in the usual Bondi null coordinate system. This Bondi frame is then related to asymptotically harmonic coordinates by means of a characteristic initial-value problem. The resultant functional relationship between the null and asymptotically harmonic frames is used to transform Bondi's radiative metric into its equivalent asymptotically harmonic form. This is compared with the radiative solution which Fock has calculated directly using harmonic coordinates. In agreement with Fock, it is found that the harmonic form of the radiation metric contains logarithmic terms. The treatment clearly shows that these logarithmic metric components do not result from the well-known logarithmic terms in the harmonic coordinate description of the light cones for Schwarzschild-like geometries. The principal result is that they arise from higher-order radiative corrections. (auth)

26714 NEW FORMULATION OF THE AXIALLY SYMMETRIC GRAVITATIONAL FIELD PROBLEM. II. Ernst, Frederick J. (Illinois Inst. of Tech., Chicago). Phys. Rev., 168: 1415-17 (Apr. 25, 1968).

The coupled Einstein-Maxwell field equations are reformulated in terms of a pair of complex functions which have especially simple forms in the case of known axially symmetric stationary solutions. The formalism affords, in particular, a simple derivation of a solution previously guessed by Newman et al. (auth)

26715 LOW-ENERGY THEOREMS FOR MASSLESS BOSONS: PHOTONS AND GRAVITONS. Jackiw, R. (CERN, Geneva. Harvard Univ., Cambridge, Mass.). Phys. Rev., 168: 1623-33(Apr. 25, 1968).

The low-energy theorems for the scattering of massless bosons are discussed. Photon and graviton scattering is examined in detail, using techniques which make no high-energy assumptions. It is shown that the low-energy form for the amplitude is given by the dispersion-theoretic Born approximation, and that the energy dependence of the neglected terms is determined by the spin of the scattered boson. It is demonstrated that Schwinger terms and sea-gull terms do not cancel in gravity theory. (auth)

26716 STATIONARY DISTRIBUTIONS OF DUST AND ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY. Banerjee, A. (Jadavpur Univ., Calcutta); Banerji, S. J. Phys., A, 1: 188-93(Mar. 1968).

Solutions corresponding to a stationary distribution of rotating charged dust with vanishing Lorentz force are given. It was found that in all but one case there were closed time-like lines. The existence is also shown of some homogeneous stationary universes other than that of Gödel and Einstein when, besides the matter field, there is also an electromagnetic field. (auth)

26717 CYLINDRICALLY SYMMETRIC MAGNETIC FIELD IN THE PRESENCE OF FREELY MOVING PARTICLES. Som, M. M. (City Coll., Calcutta). J. Phys., A, 1: 108-111(Jan. 1968).

The existence is demonstrated of a solution of the Einstein-Maxwell equations in general relativity where matter coexists with a cylindrically symmetric axial field. (auth)

26718 GLOBAL UNIQUENESS THEOREM FOR THE SOLUTIONS OF THE EINSTEIN EQUATIONS. Choquet-Bruhat, Yvonne (Institut Henri Poincare, Paris). Compt. Rend., Ser. A and B, 266: 182-4(Jan. 15, 1968). (In French).

After the necessary definitions are given, the global uniqueness theorem for the solutions of the Einstein equations is demonstrated. (tr-auth)

26719 GRAVITATIONAL FIELD OF MASSES IN ROTATION. Teyssandier, Pierre (Maison de Norvege, Paris). Compt. Rend., Ser. A and B, 266: 185-8(Jan. 15, 1968). (In French).

It is shown that in vacuum a metric of the form $ds^2 = \psi^4(r)\{dr^2 + r^2d\theta^2 + r^2\sin^2\theta\,[d\phi - F(r,\theta)dt]^2\} - V^2(r)dt^2$ is reduced necessarily to the Schwarzschild metrics and can not describe the external gravitational field of a mass in rotation. (tr-auth)

26720 GRAVITATIONAL RADIATION IN THE LIMIT OF HIGH FREQUENCY. Isaacson, Richard Allen. College Park, Md., Univ. of Maryland, 1967. 86p.

Thesis.

A technique for obtaining approximate radiative solutions to the Einstein equations of general relativity in situations where the gravitational fields of interest are quite strong is considered. The history of the problem is reviewed and previous work is discussed along related lines. The radiation is assumed to be of high frequency and the field equations are expanded in powers of the small wavelength this supplies. This assumption provides an approximation scheme valid for all orders of $1/r$, for arbitrary velocities up to that of light, and for arbitrary intensities of the gravitational field. To lowest order a gauge invariant linear wave equation for gravitational radiation is obtained which is a covariant generalization of that for massless spin-two fields in flat space. This wave equation is then solved by the W. K. B. approximation to show that gravitational waves travel on null geodesics with amplitude and frequency modified by gravitational fields in exactly the same way as are those of light waves, and with their polarization parallel transported along the geodesics, again as is the case for light. The metric containing high frequency gravitational waves is shown to be type N to lowest order, and some limits to the methods used are discussed. An extension is made beyond the linear terms in the high frequency expansion, and the lowest order nonlinear terms are considered. They are shown to provide a natural, gauge invariant, averaged effective stress tensor for the energy localized in the high frequency radiation. By assuming the W. K. B. form for the field, this tensor is found to have the same structure as that for an electromagnetic null field. A Poynting vector is used to investigate the flow of energy and momentum in the gravitational wave field, and it is seen that high frequency waves propagate along null hypersurfaces and are not backscattered off by the curvature of space. Expres-

sions for the total energy and momentum carried by the field to flat null infinity are given in terms of coordinate independent integrals valid within regions of strong field strength. The formalism is applied to the case of spherical gravitational waves where a news function is obtained, and where the source is found to lose exactly the energy and momentum contained in the radiation field. (Diss. Abstr.)

Scattering Theory

Refer also to abstracts 26693, 27291, and 27292.

26721 (ITF-67-49) VRATSATEL'NAYA ENERGIYA SISTEMY TREKH CHASTITS. (The Rotational Energy of Three-Particle System). Filippov, G. F. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 15p. (In Russian). Dep.

The operator of rotational energy and the operator of coupling between the internal motion and the rotation are constructed by changing to a coordinate system connected with the principal axes of the inertia ellipsoid. The spectrum of rotational excitations is calculated for the limiting case when the rigidity of internal vibrations is large. (auth)

26722 (JINR-P2-3590, pp 18-21) MACROSCOPIC CAUSALITY IN THE S-MATRIX THEORY. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR)).

In order to formulate the macrocausality condition a compromise is found between the description in the energy–momentum space and the description on the coordinate space. It can be shown that wave packets can be constructed as small as necessary at the moment $t_1 = -T$ and which do not essentially change their dimensions during the time $2T \gg \tau$. The conditions of macrocausality are formulated, and the case of elastic scattering is taken as an example. These conditions allow various nonlocal schemes. The example of the unitary S-matrix is indicated which is nonlocal in the conventional sense but satisfies the macrocausality condition. (J.F.P.)

26723 (JINR-P2-3590, pp 22-30) POSSIBLE DEFINITION OF MACROSCOPIC CAUSALITY. Rzewuski, J. (Wroclaw Univ. (Poland)).

An approach to the S-matrix theory in which the basic principles are relaxed only for the off-mass shell S-matrix is discussed. The S-matrix elements on the mass shell are subject to the strict postulates of local quantum field theory. Thus no problems of violating macroscopic causality arise since only the S-matrix elements on the mass shell are measurable at least in a pure scattering theory, to which the consideration is restricted. The relaxed principles obviously admit a larger class of solutions, and a possible determination of this class is attempted by various methods. A brief account of the basic principles of local quantum field theory is also given. (J.F.P.)

26724 COULOMB INTERFERENCE CORRECTIONS IN POTENTIAL SCATTERING. Auvil, P. R. (Northwestern Univ., Evanston, Ill.). Phys. Rev., 168: 1568-71(Apr. 25, 1968).

Corrections to the usual formula which approximates the total phase shift by the sum of the nuclear plus Coulomb phases are considered. The first correction to the phase is of order α (the same order as the Coulomb phase itself) and has been shown to be important in a recent analysis of pion-helium scattering. A convergent expansion in α is derived for the correction terms, and is explicitly exhibited through order α^3. The corrections are finite in each order; previously encountered logarithmic-type divergences are eliminated by a careful treatment of the asymptotic behavior of the Coulomb wave function. (auth)

26725 COVARIANT ANGULAR MOMENTUM ANALYSIS AND ANALYTIC CONTINUATION. Feldman, G. (Johns Hopkins Univ., Baltimore); Matthews, P. T. Phys. Rev., 168: 1587-93(Apr. 25, 1968).

The "little group" decomposition of a two-particle scattering amplitude is carried out using covariant variables throughout. The general covariant expression for the amplitude reproduces, where appropriate, the O(3) and O(2,1) expansions. In the limit of zero momentum transfer, for unequal masses, it goes over correctly to an expansion in the functions of the two-dimensional Euclidean group. (auth)

26726 FEYNMAN-DIAGRAM MODELS OF REGGE AND MULTI-REGGE COUPLINGS. Blankenbecler, R.; Sugar, R. L. (Univ. of California, Santa Barbara). Phys. Rev., 168: 1597-1604(Apr. 25, 1968).

Some Feynman-diagram models are presented which lead to a natural framework for discussions of the kinematic properties of Regge poles. The models do not require an infinite number of recurrences of a trajectory. The basic property of the Feynman prescriptions that is useful here is the fact that the analyticity properties of the amplitude are preserved at all stages of the calculation. The coupling of particles with integer spin to Regge trajectories is discussed in detail. These models allow one to consider various aspects of ghost-killing mechanisms and to clarify the kinematic properties, especially the kinematic singularities, of Regge residues. The extension of the discussion to the coupling of two Regge trajectories to a physical particle is carried out and applied to the multiple-Regge model of production amplitudes. Some experimental consequences of these models are briefly explored for particle production. (auth)

26727 RELATIVISTIC CLASSICAL MECHANICS WITH TIME AS A DYNAMICAL VARIABLE. Pearle, Philip M. (Case Western Reserve Univ., Cleveland). Phys. Rev., 168: 1429-44(Apr. 25, 1968).

A relativistically invariant classical Hamiltonian mechanics is presented, in which each particle is described by the eight dynamical variables of position, time, momentum, and energy. The two-particle scattering problem which consists of both inelastic scattering and elastic scattering is completely solved and reduced to quadratures. Special attention is given to elastic scattering, and it is shown that the two particles participating in elastic scattering remain at a spacelike separation with respect to each other throughout their trajectories. It is also shown that this theory is capable of describing the decay of one particle into two particles. (auth)

26728 VARIATIONAL APPROACH TO THE FADDEEV EQUATIONS. Rosenberg, Leonard (New York Univ., N. Y.). Phys. Rev., 168: 1756-65(Apr. 25, 1968).

A variational principle is formulated as a means for obtaining approximate solutions to the Faddeev integral equations for the nonrelativistic three-body scattering problem. Bound states are described by the homogeneous version of the Faddeev equations. In this case a minimum principle for the binding energies is obtained in close analogy with the familiar Rayleigh-Ritz method. An effective potential is defined as the solution of a set of modified Faddeev equations. The variational principle therefore applies to the effective potential. This is shown to be a minimum principle for the eigenphase shifts for energies below the three-particle breakup threshold. Some formal applications of the variational principle are described. These include derivations, within the Faddeev formalism, of a normalization condition for bound-state wave functions, a distorted-wave theory, and a perturbation theory for discrete states. (auth)

26729 REGGE-POLE EXCHANGE IN CLASSICAL PHYSICS AND IN NONRELATIVISTIC QUANTUM MECHANICS. Cocho, G.; Fronsdal, C.; Grodsky, I, T.; Kadyshevsky, V. G. (International Atomic Energy Agency, Trieste, Italy). Phys. Rev., 168: 1767-72(Apr. 25, 1968). (IC-67/69).

The Regge-trajectory parameter $\alpha(t)$ has a simple physical interpretation in classical relativistic scattering phenomena. The "Lorentz-pole parameter" σ of Toller has the same interpretation and is equal to $\alpha(0)$. Regge-pole exchange has a precise analog in nonrelativistic potential scattering. The relativistic Regge-Joos representation is a decomposition of the amplitude according to the nature of the exchanged object, each term transforming irreducibly under the Poincaré group; in potential scattering this group is replaced by the Galilei group. There is a specious analog of the relativistic "daughter trajectories," which now form a continuous set. Examples are worked out in detail and show a phenomenon similar to the complicated singularity structure associated with the Pomeranchuk trajectory. In the classical case, the physical interpretation imposes the requirement that $\alpha(\alpha + 1) < 0$, which means that only unitary representations of the Poincaré group can be exchanged. Similarly, only unitary representations of the Galilei group can be exchanged in nonrelativistic potential scattering. It is tempting to speculate about the possibility that similar results can be obtained in relativistic quantum theory. (auth)

26730 USE OF ITERATION PROCEDURES TO GENERATE SCATTERING APPROXIMATIONS. Manning, Irwin (Naval Research Lab., Washington, D. C.). Phys. Rev., 168: 1875-83 (Apr. 25, 1968).

The class of iteration procedures is studied which can be written as a functional $F(\psi)$ used, via the rule $\psi_{n+1} = F(\psi_n)$, to generate $\psi_0, \psi_1, \psi_2, \ldots$ desired to converge quickly to the wave function of a quantum-mechanical system. Given such a functional $F_1(\psi)$, a search is made for methods of manipulating it to obtain an improvement $F_2(\psi)$; the starting point is the functional which generates the Born expansion. Four such methods are developed which, if applied serially, are capable of generating many likely iteration procedures. Only simple potential scattering is considered, but the methods seem to promise extension to cases

much more complex. In these methods a central role is played by matrix elements J and T which measure the behavior of a functional for small and large distances from the scattering center. The resulting $F(\psi)$ are highly nonlinear; the ψ_n they generate are rational functions of the coupling constant with coefficients given by various combinations of J- and T-matrix elements. Numerical results for the first two orders of approximations are presented for square-well and exponential potentials. One of the procedures $F(\psi)$ gives the Fredholm determinantal expansion, and in a form more easily calculated than the expressions usually employed; this expansion is shown to be unitary, and a relation is obtained connecting the Fredholm determinant and a dispersion integral of the T matrix off the energy shell. Another of the improvements generates the inverse T-matrix expansion; this is shown to converge for coupling constant less than the smallest value which puts the phase shift at ±180°. In all of the above, the iteration sequence was started with ψ_0 being the free-wave solution corresponding to the scattering energy: An important advantage of iteration procedures is that, in contrast with the perturbation expansion, they are not pinned to this choice of ψ_0. The free-wave solution of a different energy is selected as input which better represents the average wavelength in the scattering region. The above iteration procedures then become much more powerful. When applied to the square-well potential, they yield the exact solution on the first iteration. (auth)

26731 S MATRIX FOR THE ONE-DIMENSIONAL N-BODY PROBLEM WITH REPULSIVE OR ATTRACTIVE δ-FUNCTION INTERACTION. Yang, C. N. (State Univ. of New York, Stony Brook). Phys. Rev., 168: 1920-3(Apr. 25, 1968).

For N particles with equal mass, interacting with repulsive or attractive δ-function interaction of the same strength, the S matrix is explicitly given and shown to be symmetrical and unitary. The incoming and outgoing states may consist of bound compounds as well as single particles. The momenta of the particles and compounds are not changed in the scattering, but particles are exchanged, such as ABC + DE → ADC + BE. Only distinguishable particles are considered. (auth)

26732 ANALYTICITY OF AN AMPLITUDE IN THE PRIMITIVE DOMAIN AS A CONSEQUENCE OF MICROCAUSALITY. Sabad, E. P. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh., 13: 433-7(Mar. 1968). (In Russian).

The proof is presented of analyticity of the scattering amplitude with respect to one four-dimensional variable in the primitive domain of momentum space without an assumption concerning its temperateness on the basis of the Bogolyubov microcausality, spectral conditions and the Meyman locality. The primitive domain consists of the future tube, the past tube, and the complex neighborhood of a certain real domain. It is shown that the amplitude grows slower than any linear exponential function in the primitive domain. The same results can be obtained if we replace the Meyman locality by the Bogolyubov microcausality. (auth)

26733 SCATTERING FROM A SEPARABLE, NON-LOCAL POTENTIAL. Cassola, R. L.; Koshel, R. D. (Ohio Univ., Athens). J. Phys., A1: 224-7(Mar. 1968).

The problem of elastic scattering from a separable, complex, non-local potential was investigated, and expressions for the phase shifts were obtained for all orders of scattering. (auth) (UK)

Particle Accelerators

Refer also to abstracts 25587, 25667, 26458, 26769, 27087, and 27090.

26734 (BNL-12418) STEADY-STATE BEAM LOADING OF THE LINAC RF SYSTEM. Lee, M. J. (Brookhaven National Lab., Upton, N. Y.). Apr. 2, 1968. 27p. Dep. CFSTI.

Two criteria which take into account the effects of steady-state beam loading have been considered theoretically for the design of a linac rf system. In one, the power transferred to the linac cavity is maximized for maximum beam current. In the other, the system is designed so that phase compensation for beam loading is not required. In general, it is not possible to have a system which meets both criteria. It was shown that for any system, zero phase compensation is always obtainable provided that the load susceptance is adjustable. However, zero phase compensation is not always attainable for a system in which the generator susceptance, line length or cavity coupling coefficient is the only adjustable parameter. (auth)

26735 (EGG-1183-2140) LINAC ELECTRON BEAM CALIBRATION. Technical Note Number S-64-TN. Lucas, A.; Rainbolt, C. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). June 1967. 23p. Dep. CFSTI.

Measurements of dose rate, field distribution, and depth dose have been made, using the external electron beam of the EG&G/AEC linac. Calcium-fluoride dosimeters were used in the determination of dose, and aluminum charge stopping blocks were used to determine flux. Data were taken for a variety of energies, distances, and beam ports. These data are summarized to assist EG&G personnel in the effective planning of experimental linac programs. (auth)

26736 (JINR-P6-3773) USTANOVKA DLYA POLUCHENIYA KOROTKOZHIVUSHIKH IZOTOROV NA PUCHKE PROTONOV SINKHROTSIKLOTRONA OIYAI I IKH SPEKTROMETRICHESKOGO ISSLEDOVANIYA. (Equipment for Short-Lived Isotope Production in the Proton Beam of the JINR Synchrocyclotron and Their Spectroscopic Investigation). Arl't, R.; Kadykova, S.; Kalinin, A.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 19p. (In Russian). Dep.

The equipment for studying short-lived isotopes in the JINR synchrocyclotron beam is described. The bombarded target is delivered by a rabbit system and is subjected to the fast chemical separation. γ- and β-irradiations of the short-lived isotopes are studied with the aid of semiconductor detectors. The analyzer AI-4096 stores the information, a magnetic tape unit introduces it into the Computer Minsk-2, where the data processing is performed by means of a light pen system. (auth)

26737 (LYCEN-6802) ETUDE ET REALISATION D'UNE SOURCE DE DEUTONS POLARISES POUR UN SYNCHROCYCLOTRON. DETERMINATION DES PARAMETRES DE LA POLARISATION DANS LA DIFFUSION ELASTIQUE $^{12}C(d,d)^{12}C$ A 28 MeV. (Study of the Development of a Source of Polarized Deuterons for a Synchrocyclotron. Determination of Polarization Parameters in $^{12}C(d,d)^{12}C$ Elastic Scattering at 28 MeV). Pin, Bernard (Lyon Univ. (France). Institut de Physique Nucleaire). Jan. 1968. 92p. (In French). Dep.

Thesis.

The studies and calculations on the development of a polarized deuteron source for the 28-MeV synchrocyclotron at the University of Lyon were given. The reasoning at the theoretical bases of the solutions employed are treated in the commonly used formalism of the density matrix. The procedures used to obtain a beam of atoms and to select in this beam the particles in energy states suitable for forming a beam of polarized ions are described in detail. These atoms are injected according to a radius in the accelerator and are ionized at the center in an original ion source. The characteristics of the beam were measured in each part of the source. The adjustment of the source, after its mounting on the accelerator, was made after measurements during the reactions of polarized deuterons on ^{12}C. The angular distributions of (d,d) and (d,p) and the asymmetry measurements permitting the estimation of the polarization rate of the incident beam were determined. (tr-auth)

26738 (NP-17333) REMARQUES GENERALES SUR LES EXPERIENCES EN CIBLE GAZEUSE. APPLICATION AUX REACTIONS $d + ^{20}Ne$ ET $d + ^{22}Ne$. (General Remarks on Experiments with Gaseous Targets. Application to $d + ^{20}Ne$ and $d + ^{22}Ne$ Reactions). Dumazet, G. (Institut d'Etudes Nucleaires, Algiers (Algeria)). June 1967. 122p. (In French). Dep.

Thesis.

The principles of the use of gas targets, either with differential pumping or with an input window, are discussed, and the experimental apparatus used is described in detail. Most of these data are reviews of work previously done at the Institut d'Etudes Nucleaires d'Alger. The automation of the data analysis, entirely original, is considered in some depth. As an illustration of the principle and use of gaseous targets, experimental results obtained by bombarding natural Ne and ^{22}Ne by deuterons at 3 and 3.2 MeV are reported. The spectra obtained and the angular distributions of different proton and α groups obtained at 3 MeV on ^{22}Ne without differential pumping are given. Two angular distributions obtained at 3 and 3.2 MeV on natural Ne are also given. (J.S.R.)

26739 (NP-17423) IPCR CYCLOTRON PROGRESS REPORT, 1967. Volume 1. (Institute of Physical and Chemical Research, Tokyo (Japan)). Nov. 1967. 96p. Dep.

The operation and development of the IPCR cyclotron are reported. Topics discussed include accelerator physics, nuclear physics, nuclear instrumentation and techniques, radiochemistry, solid state physics, radioisotope production and applications, and radiation monitoring. (W.H.K.)

26740 (UCRL-17931) BEVATRON OPERATION AND DEVELOPMENT, 54. APRIL-JUNE 1967. Crebbin, Kenneth C.; Frias, Robert (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 31, 1968. Contract W-7405-eng-48. 11p. Dep. CFSTI.

A shutdown for repairs of the motor generator sets started on

December 19, 1966, and ended this quarter. Operation for experimental physics was resumed on June 4, 1967. Construction work continued for the new two-channel external proton beam facility. A new magnet was installed in the Bevatron to study resonant extraction of the proton beam. Preliminary measurements started on the dynamics of the internal proton beam orbit shape, beam size, and ν values in preparation for resonant-extraction tests. (auth)

26741 (BNL-tr-177) LINEAR ION ACCELERATOR WITH FOCUSING BY AN ACCELERATING FIELD. Teplyakov, V. A.; Mal'tsev, A. P.; Ermakov, S. M.; Stepanov, V. B.; Shembel, B. K. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a Preprint. 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A heavy-ion linear accelerator is described which uses the double gap concept for focusing the particles with the accelerating field. One half of the gap has an axially symmetric field and the other half has, in addition, a quadrupole component. Specifications and parameters of the heavy-ion accelerator are compared to those of a proton synchrotron. (W.H.K.)

26742 ANALYSIS OF ELECTRON MOTION IN A CYLINDRICAL ELECTROSTATIC SYSTEM WITH ARBITRARY CROSS-SECTION. Liu, Sheng-wang; Liu, Shih-ming. Chin. J. Phys. (Peking) (Engl. Transl.), 21: 2543-54(Aug.-Dec. 1965).

Translated from Wu Li Hsueh Pao, 21: 2015-23(Dec. 1965).

Electron motion in a cylindrical electrostatic system with arbitrary cross-section was considered and the conditions for stationary motion and for such motion to be stable were determined. Space charge conditions were investigated and an expression for the limiting current when the system is used for focusing electron beams was obtained. The focusing capability of such systems with a parameter g_M was characterized. For concentric cylinders, the present theory yields results identical to those of previous studies. For nonconcentric cylindrical systems, the present theory provides a basis for evaluating the effect of relative displacement of the two axes; from the resulting curve, we see that the relative displacement decreases the focusing capability of the system. (auth)

26743 AVALANCHE EFFECT IN PLANE AND CYLINDRICAL GEOMETRY. Budliger, J. P.; Laisne, A. (Institut de Physique Nucleaire, Orsay, France). Nucl. Instrum. Methods, 61: 253-9(May 15, 1968). (In French).

The multipactoring effect, between two electrical plates and in a transverse electromagnetic wave in cylindrical geometry is studied, showing, in this case, a one-sided multipactor. A criterium of stability is introduced. (auth)

26744 EXPERIMENTAL DETERMINATION OF THE ENERGY LOSS, RANGE, AND STRAGGLING OF A BEAM OF 54.4-MeV α PARTICLES IN VARIOUS ELEMENTS. Tran Minh Duc; Demeyer, A.; Tousset, J.; Chery, R. (Institut de Physique Nucleaire, Lyon). J. Phys. (Paris), 29: 129-35(Feb.-Mar. 1968). (In French). (LYCEN-6744).

The ranges of 54.4-MeV alpha particles are determined in copper, silver, terbium, thullium, and gold by transmission curves with current measurements. Energy losses through a given thickness and straggling are determined with solid state detectors. (auth)

26745 LINEAR THEORY OF MOTION IN ELECTRON STORAGE RINGS. Bernardini, C.; Pellegrini, C. (Centre Nationale de la Recherche Scientifique, Frascati, Italy). Ann. Phys. (N. Y.), 46: 174-99(Jan. 1968).

The single-particle motion of electrons or positrons in storage rings is studied, giving special attention to the effects determining the beam size in general magnetic structures. (auth)

26746 MINIMUM VOLUME MICROTRON MAGNET. Peterson, G. A. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Instrum. Methods, 61: 347-8(May 15, 1968).

A description and equations are given for an analytically-based 180° racetrack microtron magnet of minimum volume with independent pole and yoke construction. (auth)

26747 ELECTRON RING ACCELERATORS A CHEAP PATH TO VERY HIGH ENERGY PROTONS. Lawson, J. D. (Rutherford Lab., Chilton, Eng.). Nature (London), 218: 430-33(May 4, 1968).

There is considerable interest in a Russian proposal for a machine in which small electron rings containing trapped protons are accelerated to high energies in a linear accelerator. The idea holds out the possibility of very high accelerating rates, and—hopefully—a relatively cheap and compact accelerator for ultrahigh energies. (auth) (UK)

26748 INFLUENCE OF INSTABILITIES ON THE FORMATION OF THE IMAGE BY ASYMMETRICALLY FED QUADRUPOLE SYSTEMS. Keck, Ch.; Liebich, W.; Pose, H. Kernenergie, 10: 350-1(Nov. 1967). (In German).

In order to evaluate the effect of the image displacement in asymmetric operation of quadrupole systems, the well-known quadrupole calculation was expanded to the particle pulse $p = p_0 (1 + \delta)$ with $\delta \ll 1$. The equations derived show that for $\delta \neq 0$, the lens properties can be traced back to the magnification, and in almost parallel-particle incidence the equations are valid. The results were compared satisfactorily with experimental determination of the width of the image boundary. Both experiment and calculations indicate that the contribution of T'_{12} is unimportant and the estimation yields usable results. (J.S.R.)

26749 INVESTIGATION OF FIELD STRUCTURES AND THE CALCULATION METHOD OF AN ACCELERATOR RESONANCE SYSTEM ON A WAVE H_{11n}. Kovpak, N. E.; Baranov, L. N.; Zeidlits, P. M.; Yamnitskii, V. A. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 13: 417-23(Mar. 1968). (In Russian).

Electric and magnetic fields of a drift tube loaded resonator are investigated. The dependence of the wave length on the loaded resonator diameter is determined to be $\lambda = 5.3$ D. It is shown that while applying drift tubes of a variable diameter the insulation in gaps operates uniformly, the accelerator length is used better. A diagram comparison is presented of the utilization of the electric field in the gaps between the tubes. The electric field on the H_{11n}-type wave is 1.9 times better than that on the E_{01n}-type wave and 1.5 times better than the one on the H_{111}-type wave. Some design formulas are presented. (auth)

26750 LENS CHARACTERISTICS FOR ELECTRODE SYSTEMS USED IN ACCELERATION TUBES. II. Gyarmati, B.; Koltay, E. ATOMKI (At. Kut. Intez.) Kozlem., 9: 319-31(Dec. 1967).

The shape and dimensions of the different gaps are defined. The analytical forms of the axial potential distributions, taken from data obtained by measurements in an electrolytic trough, are presented. The optical characteristics are described by object–image curves. (W.H.K.)

26751 PROPERTIES OF DUOPLASMATRON ION SOURCES. Valot, Ch. (Faculte des Sciences de Paris, Orsay, France). Rev. Gen. Elec., 76: 1283-7(Oct. 1967). (In French).

The principle governing the functioning of the duoplasmatron source is reviewed briefly. Influence of various parameters on the discharge—limitation of the discharge current by cathode temperature, by pressure—and on the intensity of the beam extracted—influence of the extraction voltage, discharge current, pressure, and maximum magnetic induction on the source axis—are outlined and graphed. The source is a constant-current source capable of delivering a very intense beam; the current may reach several hundred milliamperes in impulses. The beam has good optical qualities and produces a yield of 80% protons for sources operating on H_2. Effect of pressure and discharge current on the composition of the extracted beam are graphed. (BBB)

26752 DOSIMETRY AND APPARATUS FOR HEAVY ION IRRADIATION OF MAMMALIAN CELLS IN VITRO. Todd, Paul W. (Univ. of California, Berkeley); Lyman, John T.; Armer, Rollin A.; Skarsgard, Lloyd D.; Deering, R. A. Radiat. Res., 34: 1-23(1968).

Experimental techniques are described whereby cultured mammalian cells have been irradiated with stripped ion beams of ^{2}H, ^{4}He, ^{6}Li, ^{7}Li, ^{11}B, ^{12}C, ^{14}N, ^{16}O, ^{20}Ne, and ^{40}Ar. The heavy ion linear accelerators at Berkeley and Yale have both been adapted to such studies, and the methods used in each of these laboratories are presented. In both cases scattering foils have been used to spread the beam to a useful size, and thin-walled ionization chambers have been used for the dosimetry. Precautions and corrections required for beam uniformity and accurate dose measurement have been established. One method allows the cells to be irradiated in a liquid environment, and the other in a gaseous environment. The ion velocity at the cells has in one case been identical for several different ions, and in other cases it has been different for each ion. The range of linear energy transfer represented by these ions extends from 65 to 19,500 MeV-cm^2/gm. Some physical properties of accelerated ^{40}Ar ions are described. (auth)

26753 THE 42-MeV BETATRON UNIT IN THE RADIOTHERAPY SECTION OF THE COLOGNE REGIONAL GENERAL HOSPITAL. Braun, Engelbert; Petersilka, Ernst (Siemens AG, Erlangen, Ger.). Roentgen Bl., 20: 189-94(Apr. 1967). (In German).

The recommendations of the International Commission on Radiation Protection and of the Federal Government of Germany have been followed closely in construction of the 42-MeV betatron installation in Cologne. This required strict attention to several technical details. For shielding of the bunker walls and floor of the irradiation room barite concrete with a density of

3.2 g/cm³ was used. In this way, as compared to standard concrete which has a density of 2.2 g/cm³, the wall thickness could be reduced by ~30%, although the increased cost of materials had to be taken into account, too. The load factor of the barite concrete is similar to that of standard concrete. For slowing of fast neutrons a 5-cm thick asphalt layer is embedded in the walls and floors. The entrance door is provided with steel plates and paraffin shielding. It is operated remotely by motors. A door switch interrupts the irradiation if the door is not completely closed, and external warning lights are provided in the anteroom. Air conditioning of the rooms and magnet yoke is adequate. The effluent air containing whatever radioactive O and N that may be produced is directed past all adjacent structures into open air space beyond the area. These radioisotopes decay rapidly, with half lives of 2.3 and 10 min, respectively. (BBB)

26754 DEVELOPMENT OF V. I. VEKSLER'S IDEAS IN THE FIELD OF ACCELERATORS. Kolomenskii, A. A. Usp. Fiz. Nauk, 93: 593-610(Dec. 1967). (In Russian).

A brief review is given on the geographical distribution, type, and capacity of accelerators in Soviet Union and abroad. Perspectives and development of various types of accelerators are discussed and descriptions are given of the construction, performance, efficiency, and other aspects of linear, cascade, and ring cyclotrons and phasatrons and their injection systems. 35 references. (R.V.J.)

26755 INVARIANCE PROPERTIES IN CORPUSCULAR OPTICS: APPLICATION TO THE CALCULATION OF THE ACCEPTANCE OF A QUADRUPOLAR MULTIPLET. Regenstreif, Edouard (Univ., Rennes, France). Compt. Rend., Ser. A and B, 266: 142-4(Jan. 15, 1968). (In French).

Four invariance theorems that can be applied to the calculation of optical systems are announced. (tr-auth)

26756 EXPERIMENTAL STUDY OF THE TRANSITORY PHENOMENA PRODUCED DURING THE INJECTION OF A BEAM INTO AN ACCELERATING CAVITY WITH CIRCULAR IRIS. DESCRIPTION OF THE EXPERIMENTAL APPARATUS. Marcou, Jacques; Papiernik, Albert; Septier, Albert; Wartski, Louis (Faculte des Sciences, Orsay France). Compt. Rend., Ser. A and B, 266: 134-7(Jan. 15, 1968). (In French).

The injection of a high intensity beam into an accelerating cavity with circular iris modifies the radioelectric characteristics. The amplitude and phase of the hf field in the cavity is found to be perturbed by the "beam charge" (beam-loading). If this injection is made in pulses, a transitory regime is established at the beginning and at the end of each pulse, during which the phase and amplitude of the accelerating wave varies, causing a corresponding evolution of the output energy of the electrons. This phenomenon, which leads to an enlargement of the energy spectrum of the accelerated particles, was studied by developing a low energy model. The model was described. (tr-auth)

26757 PARTICLE ACCELERATOR INCLUDING MEANS FOR TRANSFERRING PARTICLES BETWEEN ACCELERATOR AND STORAGE RING. Maschke, A. W. (to United States Atomic Energy Commission). U. S. Patent 3,386,040. May 28, 1968.

An apparatus for producing a high intensity charged-particle beam in which particles are longitudinally compacted in the betatron phase space of a cyclic alternating gradient magnetic particle confining ring. Provision is made for shrinking the diameter of the beam by acceleration in a first ring, extraction and rotation of the phase space 90°, and compaction by injection of the rotated beam into the betatron phase space of a second ring. (AEC)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 26199, 26505, 26509, 27396, 27500, and 27513.

26758 (GA-8280) INTEGRAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1966–September 30, 1967. Beyster, J. R.; Antunez, H. M.; Borgonovi, G. M.; (and others) (Gulf General Atomic, Inc., San Diego, Calif.). Oct. 30, 1967. Contract AT(04-3)-167. 276p. Dep. CFSTI.

The research program and progress in the field of integral neutron thermalization are summarized for the year ending Sept. 30, 1967. Both experimental and theoretical studies are covered, as are some developments in facilities and equipment. 127 references. (D.C.W.)

26759 (GA-8485) NEUTRON PENETRATION MEASUREMENT PROGRAM. Final Report. Pigg, J. L.; Russell, J. L. Jr. (Gulf General Atomic, Inc., San Diego, Calif.). Jan. 19, 1968. Contract AT(04-3)-167. 151p. (UCRL-13336). Dep. CFSTI.

In an attempt to obtain experimental data with which to check theoretical predictions of the propagation of radiation from a weapons burst in the atmosphere, neutron dose distributions and spectra were measured as a function of distance from a 14-MeV neutron source in a tank of liquid nitrogen. Gamma doses were measured simultaneously. The experimental facility and measurement techniques are described, including the detectors and their response to neutrons from calibration sources. The resulting data are presented in graphical form. (D.C.W.)

26760 (JAERI-4043) BIBLIOGRAPHY FOR THERMAL NEUTRON SCATTERING. (Japan Atomic Energy Research Inst., Tokyo). Oct. 1967. 43p. Dep.

References (722) to literature dealing with calculations and measurements of thermal neutron scattering cross sections and with basic studies of lattice, liquid, and molecular dynamics are presented. The references are classified by the type of material. (D.C.W.)

26761 (NIJS-R-520) ATTENUATION OF FAST NEUTRONS IN UNIFORM MEDIA. Copic, M. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). Feb. 1968. 3p. Dep.

The attenuation of fast neutrons in uniform media was treated using solution of the inhomogeneous multigroup transport equation in plane geometry by the Fourier transform method. (D.C.W.)

26762 (NP-17412) CRYSTAL STRUCTURES OF TRITIDE TARGETS FOR NEUTRON GENERATORS: THE EFFECTS OF TRITIUM-TO-^{3}He DECAY. Composite Report No. E.4680. (Fulmer Research Inst., Ltd [Stoke Poges (England)]). [1966]. 32p. Dep.

The behavior of helium-3 produced by radioactive disintegration inside tritium-impregnated metal films used for neutron production by the T(d,n)^{4}He reaction is studied. The targets studied are titanium, erbium, neodymium, scandium, and yttrium. X-ray diffraction measurements were made periodically on each sample and the changes of crystal structure and lattice parameters were determined. (W.H.K.)

26763 (SC-4797(RR) DEVELOPMENT OF THE CONTROLATRON NEUTRON SOURCE TUBE (TYPE 26). (General Electric Co., Milwaukee, Wis.). May 1964. 30p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

The term controlatron refers to a class of sealed, gas-filled neutron source tubes. The design and performance of a controlatron tube for lunar analysis is presented. (W.H.K.)

26764 (SGAE-PH-60/1967) GITTERSCHWINGUNGEN IN Pt-KRISTALLEN MIT Cu-DEFEKTATOMEN. (Lattice Vibration in Pt Crystals With Cu Defects). Fiedler, H.; Eder, O. J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Physik-Institut). 1967. 11p. (In German). Dep.

Inelastic neutron scattering experiments were carried out at the ASTRA reactor in Seibersdorf on pure Pt and on Pt–Cu alloy (5 at. % Cu) at two different sample temperatures (300 and 930°K), using a rotating crystal spectrometer. The localized defect modes appearing in the neighborhood of the Cu atoms were found at 28 MeV. Balcar has developed a method for calculation of defect modes which is based on macroscopic elastic properties of the pure crystal and does not require any knowledge of the frequency spectrum. A comparison between this theory and experiment is carried out. (auth)

26765 (AERE-Trans-1084) EXPERIMENTAL STUDY OF THE NEUTRON THERMALISATION PROCESS IN TIME IN GRAPHITE AND BERYLLIUM. Mostovoi, V. I.; Sadikov, I. P.; Chernyshov, A. A.; Ishmaev, S. N.; Yudkevich, M. S.; Nozik, V. Z. Translated by J. W. Newmarch Holmes (Atomic Energy Research Establishment, Harwell, Eng.), from pp 623-41 of STI/PUB-104(Vol.1) presented at IAEA Conference on Pulsed Neutron Research, Karlsruhe, 1965. 28p. Dep. CFSTI, UK. JCL $2.60 fs, $1.10 mf.

A description is given of an experimental installation for studying the establishment of an equilibrium neutron energy spectrum in various media. Short pulses of fast neutrons were produced in the moderators under study by means of a high-current linear electron accelerator. At various intervals following the production of the fast-neutron pulse, the neutron spectra in the beam extracted from the moderator were measured by means of a mechanical chopper phased to the operation of the accelerator. The optimum resolution in spectrum measurement was 2.5 μs/m, and the minimum uncertainty in the measurement of slowing-down time was 3.5 μs. Results are given for the measurement of nonstationary spectra in graphite ($B^2 = 8.9 \times 10^{-3}$ cm^{-2}) and in beryllium ($B^2 = 9.7 \times 10^{-3}$, 24×10^{-3}, 43×10^{-3} cm^{-2}) for slowing-down times between 30 and about 2500 μs. The results measured in beryllium are compared with calculations of nonstationary spectra made with the aid of doubly differential cross-sections computed on the basis of experimental data on the energy spectrum of Be lattice vibrations. The chemical bond between the atoms of the moderator, and their thermal motion, have a marked influence upon the speed at which the neutron spectrum approaches equilibrium even with times of about 30 μs, which corresponds to an average spectrum energy of about 1 eV for graphite and about 0.2 eV for beryllium. The total time required to establish an equilibrium neutron spectrum is about 2000 μs in graphite and about 1000 μs in beryllium. The shape assumed by neutron spectra in small beryllium blocks is to a considerable extent determined by the effects of coherent scattering, the latter leading to the formation of "neutron traps" which retard the establishment of an equilibrium energy spectrum. (auth) (UK)

26766 TECHNIQUE TO MEASURE NEUTRON CROSS SECTIONS IN THE LOW keV ENERGY REGION. Simpson, O. D.; Miller, L. G. (Idaho Nuclear Corp., Idaho Falls). Nucl. Instrum. Methods, 61: 245-50(May 15, 1968).

A high-intensity beam of 2-keV neutrons having a full width at half maximum of 800 eV has been produced by placing a scandium filter in the Materials Testing Reactor. Preliminary studies have been carried out on several samples showing how the total neutron cross section at 2 keV changes as a function of sample temperature. These studies show that certain materials, particularly those with sharp resonance structure at 2 keV, exhibit marked changes in resonance self-shielding with temperature, as a result of the Doppler broadening of these resonances. (auth)

26767 SPATIAL DEPENDENCE IN THE MEASUREMENT OF THE REACTIVITY IN A SUBCRITICAL SYSTEM. Ortiz, G. Lopez; Olarte, F. J. (Junta de Energia Nuclear, Madrid). Nukleonik, 10: 329-30(Jan. 1968).

The reactivity of a heavy water–natural uranium carbide cylindrical system was measured using a 150-keV Cockcroft–Walton accelerator as the neutron pulsed source. Calculative techniques of Garelis and of Gozani were used in which system response to a neutron pulse is determined. (S.F.L.)

26768 STUDY OF THE EFFECT OF RESONANCE WIDTH ON RESONANCE ABSORPTION OF NEUTRONS IN NUCLEAR REACTORS. Johnson, Bryce Walby. Stanford, Calif., Stanford Univ., 1967. 215p.

Thesis.

The effect of the energy width of a given resonance relative to the energy loss by moderating collisions is investigated experimentally and analytically. The experiment consists of activating absorber materials (gold and thorium) by resonance-energy neutrons in a reactor core in the presence of different moderating materials to provide a wide variation in the relative resonance width. The design of the experiment permits the measured activation to be varied by as much as a factor of three by varying the moderator material. Activation rates in the presence of the different moderators are calculated by a successive-substitutions scheme developed for solving Chernick's integral conservation equation for the flux level in heterogeneous systems. The successive-substitution method is valid for any relative width of resonance, and for either extremely wide or extremely narrow resonances it duplicates the results of the commonly-used ap-

proximations which are valid for these extreme cases. Calculated activation rates agree very well with the measured values. The successive-substitutions scheme evolved for predicting foil activation rates is applied to a reactor lattice for comparison with other techniques for evaluating resonance absorption (i.e., for calculating effective resonance integrals) for a variety of relative resonance widths. The successive-substitutions scheme agrees well with the other techniques. It is described in detail for both the application to the experiment performed and the application to a reactor lattice. Computer codes which utilize the successive-substitutions method are included. Limitations on standard approximations used in evaluating effective resonance integrals are discussed in the light of the results of this investigation. (Diss. Abstr.)

26769 INTENSE NEUTRON GENERATOR. (to Atomic Energy of Canada, Ltd.). British Patent 1,106,470. Mar. 20, 1968. Priority date June 10, 1966, United States.

A neutron generator is described in which a liquid metal such as a Pb–Bi eutectic alloy is used as the proton-beam target and as the means for removing heat generated during irradiation. The liquid metal flows in a heat exchange loop by which the generated heat is extracted. (D.C.W.)

26770 ON OPTIMIZING AN Sb–Be SOURCE FOR NEUTRON RADIOGRAPHIC APPLICATIONS. Cutforth, D. C. (Argonne National Lab., Idaho Falls, Idaho). Mater. Eval., 26: 49-53(Apr. 1968).

A study of antimony-beryllium neutron sources was undertaken to determine the optimum source arrangement for neutron radiographic applications. In the study, several parameters were varied and their effects on the neutron flux distribution were noted. Three computer programs were utilized: one for calculating the antimony gamma-ray distribution, one for generating neutron group cross sections and one for making the neutronics calculations. Final computer output provided the spatial, spectral and angular distribution of the neutron flux, so the characteristics of the collimated neutron beam could be predicted. The techniques used were verified by comparing theoretical values with experimental values for one particular source arrangement. (auth)

26771 ALBEDO CRITICALITY EQUATION. Vertes, P.; Vigassy, J. (Zentralforschungsinstitut fuer Physik, Budapest). Nukleonik, 10: 334(Jan. 1968).

If a reactor system is divided into two adjacent parts by an arbitrary surface F_{ab} and the reflection operators B^{b_1} and B^{a_2} are calculated for the parts 1 and 2, the neutron distributions $\varphi_{b_1a_2}$ and $\varphi_{a_2b_1}$ from part 1 to part 2 and from part 2 to part 1, respectively, satisfy the equations $B^{b_1}B^{a_2}\varphi_{b_1a_2} = C(F)\varphi_{b_1a_2}$, and $B^{a_2}B^{b_1}\varphi_{a_2b_1} = C(F)\varphi_{a_2b_1}$, where C(F) varies from 0 to 1 as the reactor goes from subcritical to critical, and varies from 1 to ∞ as the reactor goes from critical into the supercritical region. The term C(F) also depends upon the surface F_{ab} and upon the reactor parameters. The dependence of C(F) on the surface dividing the reactor is briefly examined. (S.F.L.)

26772 DETERMINATION OF THERMAL DIFFUSION PARAMETERS OF BeO USING A PULSED NEUTRON SOURCE. Navalkar, M. P. (Bhabha Atomic Research Centre, Bombay). Nukleonik, 10: 325-6(Jan. 1968).

Using various methods of analysis (series, inverted, and buckling dependent extra polation length), it has been shown in case of room temperature BeO data, that out of three parameters that are determined, only two viz. absorption probability ($\Sigma_a V$) and thermal diffusion coefficient (D_θ) have meaningful values. The third parameter, diffusion cooling coefficient (C), shows a large variation from (3.5 to 6) $\times 10^5$ cm^4 sec^{-1}, even though the experimental points (decay constants) have been determined accurately. The values of the buckling chosen for analysis are less than the critical value above which asymptotic decay constant does not exist. This restriction on buckling values leads to poor accuracy in the measurement of diffusion cooling coefficient with the result that more sophisticated methods other than conventional method of λ-B^2 determination are necessary in order that diffusion cooling coefficient be determined with reasonable accuracy. (auth)

26773 EXTRAPOLATION DISTANCE FOR MONOENERGETIC NEUTRONS IN SLABS. VARIATIONAL CALCULATIONS. Goldschmidt, Pierre (Belgo-Nucleaire, Brussels). Nukleonik, 10: 332-4(Jan. 1968).

Three variational techniques are applied to calculate the extrapolation length for monoenergetic neutrons in slabs. It is shown that the L-2 variational method of Pomraning and Clark [J. Nuclear Energy 18: 4(1964)] leads to very accurate results for thin slabs, with no restriction for vanishing thicknesses, and that another variational principle due to Selengut [ANS Transaction 5: 1(1962)] leads to reasonably good extrapolation distances for larger slabs. Those two methods are thus complementary and lead to such simple equations that hand calculations are possible although the error is always less than 1%. Numerical results obtained from a variational principle applied to the integral transport equation using a parabolic trial function are given for comparison. (S.F.L.)

26774 INCOHERENT APPROXIMATION FOR CRYSTALLINE SCATTERING AND THE DETAILED BALANCE CONDITION. Clendenin, W. W. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Nukleonik, 10: 331-2(Jan. 1968). (LA-DC-9060).

A study is made of the incoherent approximation to the thermal neutron scattering cross section of a crystalline material. Since the integral which appears in the approximation is oscillatory, rather than convergent, it cannot obey any algebraic equality. The oscillatory integral may be replaced, in a well-known way, by a convergent integral and a term which includes a Dirac δ-function. However, since the oscillatory integral cannot obey the detailed balance condition, it is not obvious that the convergent integral obtained from it does so. A proof, based on the Riemann–Lebesgue theorem, is presented which shows that this is the case. (S.F.L.)

26775 NEUTRON SPECTRUM OF A Am–Be SOURCE. Greiss, Hans Bernd (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 10: 283-7(Jan. 1968). (In German).

The spectrum of a 10-curie Am–Be source was measured by means of the nuclear emulsion technique. The spectrum obtained chiefly confirms the results of other authors but shows a higher degree of resolution, having peaks of smaller halfwidth, a much more distinct shape of the minimum at 6 MeV and an additional peak at 9 MeV. (auth)

26776 P-ZERO CONDITION IN ROSSI–α EXPERIMENT. Szechter, Andrzej; Chwaszczewski, Stefan; Mikulski, Andrzej T. (Inst. of Nuclear Research, Swierk, Poland). Nukleonik, 10: 335-6(Jan. 1968).

A Rossi-α technique is described which is based on the measurement of the time-dependent conditional probability of neutron counts, after no counts have occurred in a specified time interval Δt_1. The experimental technique involves feeding the counts from a neutron detector into a no-count P-zero logical unit. If no count in Δt_1 occurs, a sweep of the time analyzer is started and counts from the same or another detector are registered in corresponding channels of width Δt_2. To verify the validity of the proposed technique, one-detector measurements on the Anna zero-power reactor and Monte Carlo numerical experiments were performed. (S.F.L.)

26777 PULSED NEUTRON STUDIES OF BeO WITH EMPTY CHANNELS. Joshi, B. V.; Nargundkar, V. R.; Subbarao, K. (Bhabha Atomic Research Center, Bombay). Nukleonik, 10: 323-5(Jan. 1968).

The thermal neutron diffusion parameters of BeO with empty channels were determined by the pulsed neutron method. The measurements were made for two different sets. In the axial measurements the height was varied by keeping the transverse cross-section constant; in the transverse measurements the height was kept fixed and the transverse cross section was varied. The axial and transverse diffusion parameters were then determined by second degree least squares fits. The results are compared with Behrens' theoretical calculations. (auth)

26778 SUGGESTIONS FOR THE IMPROVEMENT OF COLD NEUTRON SPECTROSCOPY. Kley, W. (EURATOM-CCR, Ispra, Italy). Nukleonik, 10: 287-92(Jan. 1968).

The conventional Be filter time-of-flight facility is used for two types of experiments: the inelastic and quasi-elastic scattering of cold neutrons. In either mode of operation the facility's resolution function is primarily determined by the time resolution of the instrument. To overcome this difficulty, it is proposed to use two new spectrometers each one specialized for one of the two cases. For the analysis of the inelastic scattered neutrons it is proposed to use a long "single" crystal of 1.2 meters length in connection with a stationary localizing detector. The resolution function of this instrument can be matched with the intrinsic energy resolution of the filtered beam. To improve the resolution and intensity for the quasi-elastic scattering, it is proposed to use the Doppler shift realized by two filters in motion at different velocities. The difference in speed can be changed at will. With a two wheel system, a tip speed difference of 1 m/sec can easily be realized in order to guarantee a resolution of 1% in the energy range of interest for the quasi-elastic and small energy transfer scattering of cold neutrons. (auth)

26779 UTILIZATION OF "A PRIORI" INFORMATION IN FAST NEUTRON SPECTROMETRY BY THRESHOLD DETEC-

TORS. Giovannini, R.; Marseguerra, M.; Menapace, E.; Motta, M. (CNEN, Bologna). Nukleonik, 10: 321-3(Jan. 1968).

The concept of unfolding neutron spectra from the experimental activations of threshold detectors to obtain "appropriate" solutions is adopted. When the non-negativity and the monotonic decreasing of the flux are assumed, "appropriate" solutions may be found in the linear programming scheme. Examples of the application of this method are given. (auth)

26780 ENERGY DEPENDENCE OF THE CROSS SECTION FOR COLD NEUTRON SCATTERING BY LIQUID GALLIUM OVER THE WAVELENGTH RANGE 1 TO 8 A. Gulko, V. A.; Maistrenko, A. N.; Razbudei, V. F. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 13: 515(Mar. 1968). (In Russian).

Previously reported data on the cross section for scattering of cold neutrons by liquid gallium were analyzed together with x-ray structural data to obtain an estimate of the coherent contribution to the cross section. It was found that the coherent effects are quite significant for neutron scattering by liquid gallium. (D.C.W.)

26781 PRODUCTION OF POLARIZED NEUTRON BEAMS BY NUCLEAR PHYSICAL METHODS. (REVIEW). Szabo, Gyula. ATOMKI (At. Kut. Intez.) Kozlem., 9: 339-60(Dec. 1967). (In Hungarian).

A review of techniques for the production of polarized neutron beams and the measurement of beam polarization is presented. 77 references. (D.C.W.)

26782 MEASUREMENTS OF DIFFUSE MAGNETIC SCATTERING OF NEUTRONS IN FERROMAGNETIC ALLOYS. Low, G. G. (Atomic Energy Research Establishment, Harwell, Eng.). Z. Angew. Phys., 24: 254-9(Apr. 1968).

Approximate cross sections for the elastic diffuse magnetic scattering of neutrons from disordered ferromagnetic alloys are briefly discussed. The experimental measurements of such scattering are then reviewed under the four headings: the Shull–Wilkinson method applied to 3d-transition metal alloys, dilute Fe-based alloys, dilute Ni-based alloys and Pd alloys. (auth)

26783 CHECKING OF NEUTRON DIFFUSION THEORY WITH PULSE METHOD. Zhezherun, I. F. At. Energ. (USSR), 24: 33-8(Jan. 1968). (In Russian).

Experiments on the diffusion of neutrons in graphite media comprised of square lattices of cylindrical channels with radius 0.8 cm and steps of 2.0 cm (with ratio of the empty volume to the volume of solid material r + 1.01) are described. Studies were also made on solid graphite, for which all channels were filled with graphite rods. The decay constant λ in the graphite blocks of different dimension, having the form of rectangular parallelepipeds, was measured. The analysis of the dependence of λ on the geometric parameter B^2 for solid graphite and on the longitudinal and perpendicular parameters $B^2_{\parallel}$ and $B^2_{\perp}$ for graphite with channels gave the possibility of obtaining the diffusion coefficients and the diffusion cooling for this material and ratios between them. (tr-auth)

26784 NEUTRON GENERATOR SHIELDING ARRANGEMENT. Adachi, Takeshi (to Tokyo Shibaura Electric Co., Ltd). U. S. Patent 3,345,515. Oct. 3, 1967. Priority date July 15, 1963, Japan.

A d–T neutron source is described in which the target structure is located near the ground floor of the facility, permitting the ground to serve as part of the shielding and permitting the shielding around the target to support the neutron generator. (D.C.W.)

26785 NEUTRON GENERATOR TUBE HAVING A SEALED-IN GAS REPLENISHER. Bounden, John Ellery (to United Kingdom Atomic Energy Authority). U. S. Patent 3,344,299. Sept. 26, 1967. Priority date Jan. 14, 1963, Great Britain.

A d–D and d–T neutron generator tube is described in which ions are accelerated across a gap that contains gas at essentially the same pressure as the gas in the ion source. The ion source and accelerating gap are contained in a sealed envelope, and a gas replenisher is included within the sealed envelope. (D.C.W.)

26786 NEUTRON GENERATING APPARATUS HAVING A TARGET CONTAINING BOTH DEUTERIUM AND TRITIUM GASES. Arnold, Wayne R. (to Schlumberger Technology Corp.). U. S. Patent 3,350,563. Oct. 31, 1967. Filed Mar. 8, 1963.

A neutron generator that is particularly suited for well logging is described. The generator features automatic flux control in response to either the flux of emitted neutrons or the flux of slowed neutrons. A pressure control system for maintaining the pressure of deuterium gas in the ion source at a preselected value is also included. (D.C.W.)

26787 MEASUREMENT OF FAST NEUTRON SPECTRA IN WATER AND GRAPHITE. Harris, Lawrence Jr. Ann Arbor, Mich., Univ. of Michigan, 1967. 123p.

Thesis.

Detailed knowledge of the energy and spatial distributions of fast neutrons in bulk media is required in radiation shielding, radiation effects, and fast reactor physics. Although computer codes are available to calculate spatially dependent spectra with accuracies presumably limited only by uncertainties in cross sections and source spectra, few spectrum measurements which provide a good test for these calculations have been reported. Here a relatively simple, moderate resolution (12%), differential proton-recoil, fast neutron spectrometer has been developed to measure directed neutron fluxes in the presence of high intensity fission gamma fields of 10^7 to 10^8 roentgens/hour. Good signal-to-background ratios are obtained by careful shielding, using silicon surface-barrier detectors, positioning the detectors out of the collimated beam of mixed radiation which traverses the thin polyethylene (CH_2) radiator, and using tandem detectors in anticoincidence. The efficiency is about 10^{-6} for neutrons incident on the radiator. Measurements of the energy spectrum from 2 to 12 MeV of normally directed neutrons which leaked from the Ford Nuclear Reactor core and penetrated 0, 20.0, 40.0, and 60.0 cm of H_2O and 0, 20.2, 40.4 and 60.6 cm of graphite are reported. The relatively high accuracy of these deep penetration measurements (±10% relative intensity and ±20% absolute intensity, ±2% energy) makes them useful for testing calculations. Comparison with detailed transport calculations shows good agreement. (Diss. Abstr.)

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Refer also to abstracts 26831, 26866, 27248, 27252, 27289, and 27319.

26788 (KFK-679) INVESTIGATION OF THE T = 0 NEGATIVE PARITY EXCITED STATES IN ^{4}He. Haase, E. L.; Brueckmann, H.; Kluge, W.; Schaenzler, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Oct. 1967. 12p. (CONF-670629-7). Dep.

From Symposium on Light Nuclei, Few-Body Problems, and Nuclear Forces, Brela, Yugoslavia.

Using inelastic scattering of 52 MeV-deuterons and 104-MeV alpha particles, excited states in ^{4}He were investigated. These reactions selectively only excite T = 0 levels. The results are consistent with the assignments from a phase-shift analysis of T(p,p)T and ^{3}He(n,n)^{3}He data. Making assumptions about the reaction mechanism, positions and widths for two states are extracted. (auth)

26789 (LAL-1191) CORRELATIONS IN ^{4}He FROM ELASTIC ELECTRON SCATTERING. Stovall, Tannie; Vinciguerra, Domenico (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). May 1968. 8p. Dep.

The treatment of nucleon correlations through a Jastrow-type wave function of the form: $\psi(r_1, r_2, r_3, r_4) = N \exp[(-\frac{1}{2}(r_1^2 + r_2^2 + r_3^2 + r_4^2)/a_0^2)] \times [\prod_{i<j}(1 - f_{ij})]^4$, where a_0 is the usual harmonic oscillator size parameter and a Gaussian form of f_{ij}: $f_{ij} = \exp[-(r_i - r_j)^2/d^2]$ is assumed, was studied. It was shown that a small hard-core radius (the parameter d is related to the hard-core repulsion) can affect the wave function even at considerable ranges and that even if d is small in comparison to a_0, great care must be exercised in dropping terms corresponding to products of many f_{ij}. (D.C.W.)

26790 (p,p) AND (n,n) SCATTERING LENGTHS FROM (^{3}He,d) AND (t,d) REACTIONS. Haybron, R. M. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A112: 594-602(1968). (ORNL-P-3618).

The triton energy spectrum from the reaction ^{3}He(d,t)2p and the ^{3}He spectrum from t(d,^{3}H)2n were studied to determine the range of applicability of the Watson-Migdal (W-M) theory of final-state interactions as a means of extracting two-nucleon scattering lengths from such experiments. By comparing the predictions of W-M theory to more exact calculations, it was found that the value of scattering length predicted is, in general, too large in magnitude. For the pick-up process where the two final state nucleons originate in the relatively compact t or ^{3}He wavefunction, the usefulness of W-M theory is marginal; for charge exchange where the final state nucleons originate in the deuteron, the W-M prediction is substantially in error. These results are in complete agreement with Watson's original statement of the problem. (auth)

26791 SUM RULES FOR THE d(γ,n)p PROCESS EMPLOYING REALISTIC POTENTIALS. Lucas, J. G.; Rustgi, M. L. (State Univ. of New York, Buffalo). Nucl. Phys., A112: 503-12(1968).

Employing the Yale and Hamada-Johnston potentials, the bremsstrahlung-weighted and integrated cross sections have been evaluated for the d(γ,n)p process. The electric polarizability of the deuteron is also calculated. The results are compared with experiments by numerically integrating the total cross-section curve versus the energy of the γ rays (E) for three months weighting 1, E^{-1} and E^{-2}. The results are found to be quite insensitive to the details of these potentials. A study of the sum rules for the photodisintegration of the deuteron therefore may not provide any important information which may be useful in distinguishing between the various nucleon-nucleon potentials. (auth)

26792 EFFECTS OF TRUNCATION IN NUCLEAR HARTREE–FOCK CALCULATIONS. Bassichis, W. H. (Univ. of California, Livermore); Pohl, B. A.; Kerman, A. K. Nucl. Phys., A112: 360-71(1968). (MIT–2098-395).

Hartree-Fock calculations were carried out for the doubly even nuclei with A = 4 to A = 80 in a space consisting of the $1s_{\frac{1}{2}}$ to the $1i_{\frac{13}{2}}$ harmonic oscillator states inclusive. The results are compared to results of a previous HF calculation in which the space was truncated at the top of the 2p-1f shell. The effects of the truncation are found to be more pronounced for deformed nuclei than for the spherical nuclei, where convergence has been previously studied. As expected, the quadrupole moment is found to be quite sensitive to this extension of the space, while the binding energy, rms radius and the kinetic energy per particle are not. Center-of-mass effects, compressibility, and deformability are also studied, and a few nuclei with $80 \leqq A \leqq 208$ are considered. (auth)

26793 RADIATIVE TRANSITIONS IN 3-NUCLEON SYSTEMS. Griffiths, G. M.; Bailey, G. M.; Donnelly, T. W. (Univ. of British Columbia, Vancouver). Nucl. Sci. Appl., 3: 1-6(Oct. 1967).

Estimates are made of the relative importance of M1, E1, and E2 transitions and interference between them in both the radiative capture of neutrons and protons by deuterium and the 2-body photodisintegration of H^3 and He^3. A square-well model is used to represent the interaction of the odd particle with the deuteron in both continuum and bound states. Using this relatively crude model, the theory gives results for the main electric dipole photodisintegration cross section in good agreement with experiments over the energy range up to 40 MeV and with three-body calculations. Interference between E1 ($^2P-{}^2S$) and E2 ($^2D-{}^2S$) transitions is shown to be significant in the capture and photodisintegration reactions. The reactions D(n,γ)T and D(p,γ)He^3 are compared at low energies and the importance of the $^2S'$ mixed symmetry and ^4D states in the mass-3 ground state are considered. The interpretation of the isotropic component of the capture radiation at low energies in terms of the $^2S'$ state amplitude in the ground state is complicated by the presence of E1 transitions involving the ^4D component of the ground state. (auth)

26794 BORN-APPROXIMATION FORMULATION OF NEUTRON–DEUTERON SCATTERING WITH TENSOR INTERACTION. Purrington, Robert D.; Gammel, J. L. (Texas A and M Univ., College Station). Phys. Rev., 168: 1174-80(Apr. 20, 1968).

The Born approximation for n-d scattering is calculated for a nucleon-nucleon interaction which includes a tensor term. The l = 0 parts of the resulting scattering amplitude are adjusted to obtain a fit to the n-d elastic angular distributions. Spin-polarization phenomena are then calculated, with good agreement with experiment. (auth)

26795 ALPHA–ALPHA SCATTERING BY ONE-BOSON-EXCHANGE POTENTIALS. Payne, G. (Univ. of Iowa, Iowa City). Phys. Rev., 168: 1181-3(Apr. 20, 1968).

Theoretical phase shifts are obtained for α–α elastic scattering, using one-boson-exchange potentials, at higher energies (40- to 100-MeV lab energy), where, it is argued, both exchange and polarization can be neglected. It is pointed out that the study of α–α scattering can be useful in determining meson-nucleon coupling constants, since selection rules prevent the direct exchange of some of the mesons that contribute to nucleon-nucleon scattering. In particular, one set of meson-nucleon coupling constants is shown to be inadequate, and strong support is given to a second set. Comparison with the methods used in previous calculations at lower energies is made, and an ambiguity in the definition of the one-boson-exchange potential is pointed out. (auth)

26796 PROTON–PROTON BREMSSTRAHLUNG AT 61.7 MeV. Halbert, M. L. (Oak Ridge National Lab., Tenn.); Mason, D. L.; Northcliffe, L. C. Phys. Rev., 168: 1130-8(Apr. 20, 1968). (ORNL-P-3518).

The two final-state protons in the reaction $p + p \rightarrow p + p + \gamma$ at 61.7 ± 0.1 MeV were detected by (ΔE,E) telescopes placed at 30° on opposite sides of the beam. About 250 events were detected in a geometry with angular acceptance comparable to the maximum possible noncoplanarity. Additional data were obtained with apertures of smaller height, restricting the measurement to a more nearly coplanar geometry. The data indicate that the cross section is smaller for noncoplanar events. The estimated coplanar cross sections and differential cross section as a function of γ-ray angle are presented. The results agree with recent theoretical predictions. (auth)

26797 NEUTRON-HELIUM INTERACTION. II. ANGULAR DISTRIBUTIONS AND PHASE SHIFTS FROM 0.2 TO 7.0 MeV. Morgan, G. L.; Walter, R. L. (Duke Univ., Durham, N. C.). Phys. Rev., 168: 1114-30(Apr. 20, 1968).

Precision relative differential cross sections for the scattering of neutrons from helium were measured at 22 neutron energies between 0.2 and 7.0 MeV. The measurements were made by observing the energy distribution of the recoiling helium nuclei in a high-pressure helium-gas scintillation counter irradiated by monoenergetic neutrons. An analysis of the data was made in terms of phase shifts. The data could be satisfactorily represented without the use of partial waves higher than l = 1. The energy dependence of the phase shifts was found to be in good agreement with that predicted by single-level dispersion theory. Proton-helium phase shifts were calculated from the neutron-helium phase shifts and found to be in fair agreement with the existing data. It is shown that a Saxon-Woods potential can accurately represent the scattering of protons and neutrons from helium for energies at least up to 5 and 8 MeV, respectively. (auth)

26798 NEUTRON-HELIUM INTERACTION. I. SCATTERING OF POLARIZED NEUTRONS AT 1.01 AND 2.44 MeV. Sawers, J. R. Jr.; Morgan, G. L.; Schaller, L. A.; Walter, R. L. (Duke Univ., Durham, N. C.). Phys. Rev., 168: 1102-13(Apr. 20, 1968).

Precision angular distributions of the asymmetry in the scattering of 1.015- and 2.44-MeV polarized neutrons from helium were determined. The reactions $^7Li(p,n)^7Be$ and $^{12}C(d,n)^{13}N$ served as neutron sources, and target thicknesses of 46 and 175 keV, respectively, were used. Analyzing angles ranged from 30 to 140°, in 10° increments. A spin-precession solenoid was employed and the helium was contained in a high-pressure scintillation cell. It is demonstrated that asymmetry data alone are sufficient to accurately determine the scattering phase shifts at 2.44 MeV. Here the phase-shift values were found to be 142.1, 21.2, and 121.6° for the δ_0, δ_1^1, and δ_1^2 phase shifts, respectively. d waves were not found to be necessary. Assuming hard-sphere scattering, the s-wave phase shift gives a radius of 2.42 F, which is consistent with the values recently obtained by others from both n-He and p-He scattering data. Since at 1.015 MeV, equally good fits to the present data could be obtained with values of δ_0 differing by as much as 15°, the hard-sphere formula was used in conjunction with the scattering radius determined at 2.44 MeV to fix the s-wave phase shift at 155.5°. The fit to the data then required that $\delta_1^1 = 4.4°$ and $\delta_1^2 = 61.2$. The presently determined s-wave phase shifts are larger than the commonly accepted ones due to Dodder, Gammel, and Seagrave (DGS). At both energies the δ_1^2 was in excellent agreement with DGS, although δ_1^1 is about 1.6° below DGS at 1.015 MeV, and 2.8° above at 2.44 MeV. (auth)

26799 TWO-BODY PHOTODISINTEGRATION OF ^{3}He. Carron, N. J. (Univ. of Illinois, Urbana). Phys. Rev., 168: 1095-1101(Apr. 20, 1968).

A discussion and comparison of the two forms of interaction, $A \cdot p$ and $E \cdot r$, are given for two-body photo-disintegration of ^{3}He. It is shown that in general the $E \cdot r$ results are much better than the $A \cdot p$ results. Calculations are carried out to 140 MeV to compare with recent data. The Gunn-Irving wave function gives a good fit to the total cross section at all energies, but fails to account for the ground-state matter form factor. A simple three-nucleon ground-state wave function is suggested which adequately reproduces the Coulomb energy, rms radius, and matter form factor (for $q^2 \lesssim 3.5$ F^{-2}) of ^{3}He, but predicts a photodisintegration cross section which is 20% small at the peak, assuming no final-state interactions. The spin magnetic-moment interaction, which Verde has shown is forbidden in the dipole approximation for transitions from a spatially symmetric ground state, is computed without this approximation and is shown to contribute only 1 to 10% of the total cross section, the larger amount only at high energies. (auth)

26800 POLARIZATION IN THE ELASTIC SCATTERING OF 30-MeV PROTONS BY ^{3}He. Harbison, S. A. (Westfield Coll., London); Kingston, F. G.; Griffiths, R. J.; Johnston, A. R.; Megaw, J. H. P. C. Nucl. Phys., A112: 137-44(1968).

The polarization in p-^{3}He elastic scattering at 30 MeV in the angular range 33 to 160° cms was measured. The magnitude of the polarization is very much greater than that predicted from an optical-model analysis of cross-section data, but is consistent with the values found at lower energies. (auth)

26801 DEUTERON CAPTURE IN ^{3}He. Buss, W.; Del Bianco, W.; Waeffler, H.; Ziegler, B. (Max-Planck-Inst. for Chemistry, Mainz). Nucl. Phys., A112: 47-64(1968).

Gamma-ray spectra from the ^{3}He(d,γ)^{5}Li reaction, measured over the range E_d = 0.2–1.2 MeV with a high-resolution NaI two-crystal pair spectrometer, consist of transitions to the ^{5}Li ground state (Γ = 2.6 ± 0.4 MeV) and first excited state (E_x = 7.5 ± 1.0 MeV; Γ = 6.6 ± 1.2 MeV). The intensity ratios of the two lines is 1.00 ± 0.15 and 1.9 ± 0.4 at E_d = 480 and 1025 keV, respectively. The 90° ground-state transition yield curve shows a resonance at E_d = 450 keV ($\Gamma_{\gamma 0}$ = 5 ± 1 eV) with a total cross section of 21 ± 4 μb. At higher energies the reaction proceeds mainly through nonresonant capture. The ground-state angular distributions were measured at 480 and 1025 keV. The results are consistent with the assumption of pure s-wave capture through a resonance reaction with channel spin $^3/_2$ and a direct reaction with channel spin $^1/_2$. The measured spin-orbit splitting of the two p-levels in ^{5}Li agrees within experimental errors with the value extrapolated from measured spin-orbit splitting energies of higher-Z nuclei. (auth)

26802 AN OPTICAL MODEL FOR THE SCATTERING OF NUCLEONS FROM ^{4}He AT ENERGIES BELOW 20 MeV. Satchler, G. R. (Oak Ridge National Lab., Tenn.); Owen, L. W.; Elwyn, A. J.; Morgan, G. L.; Walter, R. L. Nucl. Phys., A112: 1-31 (1968). (ORNL-P-3697).

A real optical model potential of Woods–Saxon form is obtained which closely reproduces the observed scattering of neutrons and protons from ^{4}He at bombarding energies below 20 MeV. Two parameters are allowed to depend linearly on the energy. The spin-orbit coupling term peaks inside the central potential. There are indications of small differences between the potential strengths required for neutrons and protons. The phase shifts obtained from this model are presented in tabular form. Possibilities for further studies are discussed. (auth)

26803 TRINUCLEON THREE-BODY PHOTODISINTEGRATION. Gibson, Benjamin F.; Goldberg, Abraham (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl. Phys., A111: 569-76(1968). (UCRL-70678).

Corrections to the three-body photodisintegration cross section due to the use of an S-state containing a soft core and the inclusion of admixed states of the S′ and D type in the ground state, and to final-state interactions between nucleons in relative s-states are calculated. A satisfactory fit to the data is obtained for energies up to the peak cross section. (auth)

26804 STUDY OF THE EXCITATION STATE OF ^{4}He AND ^{4}Li NUCLEI PRODUCED IN NUCLEAR REACTIONS. Jacquot, Claude; Jung, Monique; Baixeras-Aiguabella, Carmen (Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., Ser. A and B, 266: 193-8(Jan. 15, 1968). (In French).

The states of ^{4}He and ^{4}Li were studied in the reaction products induced by 800-MeV/c α particles on the light nuclei of the emulsion. There was good agreement with previous studies, and the possibility of a new resonance at 38 MeV for ^{4}He was indicated. (tr-auth)

26805 DIFFERENTIAL CROSS SECTIONS IN PROTON–PROTON SCATTERING AT 52.34 MeV. Sanada, J. (Tokyo Univ. of Education); Kuriyama, K.; Takeuchi, Y.; (and others). pp 2 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26806 MEASUREMENT OF THE SPIN CORRELATION PARAMETERS A_{xx} AND A_{yy} OF PROTON–PROTON SCATTERING AT 50 MeV. Nisimura, K. (Kyoto UnivJ; Hasegawa, T.; Kusakari, H.; Horikawa, N.; Kikuchi, K.; Masaike, A.; Sugimoto, S.; Yamaki, T.; Yoshida, K. pp 3 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26807 ANGULAR DISTRIBUTION OF THE d(p,n)2p REACTION AT 45.5 MeV. Margaziotis, Demetrius J. (Univ. of California, Los Angeles. California State Coll., Los Angeles); Wright, Byron T.; van Oers, W. T. H. pp 13 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26808 D(p,2p)n REACTION AT THE INTERMEDIATE ENERGY. Kuroda, K.; Takeuchi, F.; Yuasa, T. (Institut de Physique Nucleaire, Orsay, France). pp 14 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26809 RECOIL DEUTERONS AND BREAKUP PROTONS FROM THE n–d INTERACTION AT 14.1 MeV. Shirato, S.; Koori, N. (St. Paul's Univ., Tokyo). pp 15 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26810 INVESTIGATIONS OF THREE- AND FOUR-NUCLEON SYSTEMS. Bar-Avraham, E.; Carlson, R. F.; Chang, C. C.; Forster, H. H.; Kim, C. C.; Richardson, J. Reginald; Slaus, I.; Tomas, P.; van Oers, W. T. H.; Verba, J. W. (Univ. of California, Los Angeles). pp 16 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967. (UCLA–10P18–1).
See CONF-670910.

26811 EXTRACTION OF 2-BODY PARAMETERS FROM KINEMATICALLY COMPLETE 3-BODY EXPERIMENTS. Donovan, P. F. (Bell Telephone Labs., Murray Hill, N. J.); Mollenauer, J. F.; Boyd, D. P.; Zupancic, C. pp 17 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26812 BINDING ENERGY OF TRITONS. Sasakawa, T.; Tsukamoto, T.; Matsuzaki, H. (Tohoku Univ., Sendai). pp 19 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26813 COULOMB ENERGY OF ^{3}He AND LOCAL AND NONLOCAL POTENTIALS. Okamoto, K.; Lucas, C. (Univ. of New South Wales, Kensington). pp 20 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26814 NUCLEAR THREE-BODY PROBLEM WITH SEPARABLE NONLOCAL INTERACTION WITH HARD-SHELL REPULSION. Borysowicz, J.; Dabrowski, J.; Dworzecka, M.; Trych, E. (Univ., Warsaw). pp 22 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26815 GROUND-STATE WAVE FUNCTION OF ^{3}H AND ^{3}He NUCLEI. Ohmura, Takashi (Nihon Univ., Tokyo). pp 24 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26816 REACTION MATRIX CALCULATIONS FOR ^{4}He, ^{3}He, AND ^{3}H USING THE HAMADA–JOHNSTON POTENTIAL. Becker, R. L.; Morris, B. M. (Oak Ridge National Lab., Tenn.). pp 27 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26817 FOUR-NUCLEON SYSTEMS WITH REALISTIC FORCES. de Llano, Manuel (Univ. Nacional de Mexico, Mexico City). pp 28 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26818 THE EFFECT OF THE EXCLUSION PRINCIPLE BETWEEN VALENCE PAIR AND THE RENORMALIZED CORE IN ^{6}Li. Richardson, Roger (Fordham Univ., New York); Shapiro, Joseph; Malik, F. Bary. pp 33 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26819 THE Dd REACTIONS WITH POLARIZED DEUTERONS AT 460 keV ENERGY. Huber, P.; Schieck, H. Paetzgen; Petitjean, C.; Striebel, H. R. (Univ. of Basel). pp 36 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26820 STUDY OF THE EXCITED STATE OF ^{4}He(γ,p)^{3}H REACTION. Sanada, J.; Yamanouchi, M; Sakai, N. (Tokyo Univ. of Education). pp 37 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Toyko, Tokyo Univ., 1967.
See CONF-670910.

26821 ANGULAR DISTRIBUTIONS OF CHARGED PARTICLES FROM THE INTERACTION OF 14.4-MeV NEUTRONS WITH TRITONS AND ^{3}He. Tomas, P.; Antolkovic, B.; Basar, I.; Paic, G.; Rendic, D. (Inst. Rudjer Boskovic, Zagreb). pp 38 of

Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26822 BREAKUP OF DEUTERON BY ALPHA PARTICLE IMPACT. Fukunaga, K.; Tanabe, T.; Yamashita, S.; Fujiwara, N.; Kakigi, S.; Yanabu, T. (Kyoto Univ.). pp 39 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26823 CAPTURE GAMMA RAYS FROM ^{3}He PLUS ^{3}He. Stephens, W. E.; Harrison, W. D.; Tombrello, T. A.; Winkler, H. (California Inst. of Tech., Pasadena). pp 40 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26824 ELASTIC SCATTERING OF ^{4}He(t,t)^{4}He AND ^{4}He(^{3}He,^{3}He)^{4}He FROM 1.4 TO 3.0 MeV. Sanada, J.; Chuang, L. S. (Tokyo Univ.). pp 42 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26825 INTERACTION BETWEEN ^{3}He AND ^{4}He. Okai, Sueji (Niigata Univ., Japan). pp 43 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26826 INTERACTION BETWEEN α-PARTICLES. Abe, Y.; Endo, O.; Tamagaki, R.; Tanaka, H. (Hokkaido Univ., Sapporo). pp 45 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26827 PHOTODISINTEGRATION OF ^{4}He. Gorbunov, A. N. (Lebedev Inst. of Physics, Moscow). pp 376 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26828 PION ABSORPTION AND NUCLEAR CORRELATIONS IN ^{3}He. Shah, M. S.; Pandya, S. P.; Mitra, A. N. (Physical Research Lab., Ahmedabad, India). pp 411 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26829 THE PRODUCTION OF TRITIUM FROM ^{4}He BOMBARDED BY HIGH-ENERGY PROTONS. Lebowitz, Elliot. New York, Columbia Univ., 1967. 86p.
Thesis.

In this experiment, the cross section for the reaction p + ^{4}He → T + 2N + nπ was measured at 2.2 BeV. A more accurate radiochemical system for measuring tritium produced in nuclear reactions was developed and was used in this experiment. The results of this work are significant for the study of nuclear reaction mechanisms and space science. Additional experiments employing this radiochemical system are suggested. (Disser. Abstr.)

26830 TWO-BODY CALCULATIONS FOR THE DIRECT RADIATIVE REACTIONS D(p,γ)^{3}He, ^{3}He(γ,p)D AND ^{16}O(p,γ)^{17}F. Donnelly, Thomas William. Vancouver, B.C., Univ. of British Columbia, 1967.
Thesis.

The direct radiative capture reactions D(p,γ)^{3}He and ^{16}O(p,γ)^{17}F both of which are of interest in astrophysical processes, were studied theoretically using a simple two-body direct radiative capture model in order to estimate the cross sections at low energies. In addition, the time inverse of the first reaction, namely the photodisintegration of He^3, was studied for high excitation energies in He^3 by applying the reciprocity relations to the direct capture theory. The calculations involve taking matrix elements of the particle-radiation interaction Hamiltonian between bound and continuum states and using first-order perturbation theory to obtain the cross sections. Bound-state wave functions are generated in simple potentials involving square-well and Saxon-Woods forms with appropriate Coulomb barriers and with one free parameter which is adjusted to fit the binding energy. The potential parameters for the continuum state wave functions are adjusted to fit available scattering data. For the reaction ^{16}O(p,γ)^{17}F the cross sections for transitions to both the ground and first excited states are in good agreement with the somewhat limited experimental data from 150 keV to 2.5 MeV and the astrophysical S-factors are shown to be energy dependent even at energies below 100 keV. The photodisintegration cross section for the reaction ^{3}He(γ,p)D is well fitted in the neighbourhood of the peak at around 11 MeV as well as at lower energies. The D(p,γ)^{3}He direct capture cross sections in the energy range around 1 MeV are shown to be sensitive to admixtures of ^{2}S-state of mixed symmetry and of ^{4}D-state in the ground state of He^3, which is predominantly symmetric ^{2}S. The same model including the ^{2}S-state of mixed symmetry leads to a capture cross section for thermal neutrons by deuterons in good agreement with the experimental value. (Diss. Abstr.)

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Refer also to abstracts 26572, 26605, 26739, 26792, 26804, 26830, 26929, 26931, 26932, 26948, 26949, 26958, 26989, 27004, 27007–27009, 27029, 27073, 27238, 27243, 27262, 27271, 27295, 27300, 27344, 27359, 27380, 27381, and 27389.

26831 (BNL–12344) EXPERIMENTAL WORK USING PROTONS. Palevsky, Harry (Brookhaven National Lab., Upton, N. Y.). Mar. 19, 1968. 45p. (CONF-680314–1). Dep. CFSTI.

From Symposium on the Use of Nimrod for Nuclear Structure Physics, Chilton, England.

Some experiments that were performed using high-energy beams from the Cosmotron are reviewed. Results on the p-p elastic differential cross section; the quasielastic reaction ^{12}C(p,2p); deuteron production in proton reactions with ^{12}C, ^{4}He, Pb, ^{6}Li, and ^{16}O at 1 GeV; and proton elastic scattering by ^{12}C, D, ^{4}He, H, and ^{16}O at 1 GeV are discussed. (D.C.W.)

26832 (ORNL–4105) COMPARISON OF CALCULATED RADIOCHEMICAL CROSS SECTIONS WITH EXPERIMENTAL RESULTS FOR INCIDENT PROTONS AND π^- MESONS IN THE 50- TO 400-MeV REGION: EFFECT OF VARYING A FEW NUCLEAR PARAMETERS IN THE CALCULATIONS. Bertini, Hugo W. (Oak Ridge National Lab., Tenn.). Apr. 1968. Contract W-7405-eng-26. 59p. Dep. CFSTI.

Comparisons are made between theoretical predictions and experimental data for several (p,xpn) reactions involving C, Al, Cu, and U and for the (π^-,π^-n) reaction in carbon. Interaction energies range from about 50 to 400 MeV. The theoretical model employs the two-step cascade-evaporation mechanism and includes the effect of the diffuse nuclear surface. The comparisons for the proton-initiated reactions indicate that agreement to within about 40% can be expected when the reaction cross section is about 100 mb, but the values can differ by factors of 5 or more when the cross section is about 10 mb. The agreement for the (π^-,π^-n) reaction on carbon was fair. This reaction can be used for the measurement of the real part of the optical-model potential, and the method for doing so is described. The effects of the diffuse nuclear surface in conjunction with changes in the nuclear radius on the (p,pn) reaction are discussed. Finally, results are given for the dependence of the (p,xpyn) cross sections on the transition energy used in the calculation between the cascade and evaporation processes. A tabulation of calculated and experimental cross sections, which includes all those used in this study, is attached as an appendix. (auth)

26833 PHOTOPROTONS FROM ^{16}O. Thompson, M. N.; Baglin, J. E. E. (Yale Univ., New Haven). pp 386 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26834 PHOTOPROTONS FROM LITHIUM AND CARBON WITH 100-MeV BREMSSTRAHLUNG. Matthews, J. L.; Bertozzi, W.; Kowalski, S.; Sargent, C. P.; Turchinetz, W. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys., A112: 654-88(1968). (MIT-2098-405).

Measurements were carried out of the distribution in energy and angle of the high-energy protons emitted in the photodisintegration of ^{6}Li, with some limited studies also of ^{7}Li and ^{12}C. The experiments were performed at the University of Saskatchewan Accelerator Laboratory using a 100-MeV bremsstrahlung beam. Protons of energies between 40 and 95 MeV were detected with about 4% resolution, at eight angles from 45 to 126° by an array of plastic scintillation counter telescopes. Proton spectra for "monochromatic" photons were obtained by forming a properly normalized difference between spectra measured with 102 and 95 MeV bremsstrahlung beams. The ^{6}Li(γ,p) data are compared with the prediction of a phenomenological quasi-deuteron model, and this model is found to reproduce satisfactorily the shape and scale of the data over the entire range of the measurement. The experimental results are also discussed in terms of a single-particle model. A Born approximation calculation using shell-model wave functions

does not provide sufficient amplitudes at high momenta to account for the ^{6}Li(γ,p) data. (auth)

26835 THE FIRST EXCITED STATE OF ^{8}Be. Cockburn, P. M.; Grant, I. S. (Univ. of Manchester, Eng.). Nucl. Sci. Appl., 3: 10-15(Oct. 1967).

The broad first excited state of ^{8}Be at 2.9 MeV was investigated through the reactions ^{7}Li(p,γα)^{4}He and ^{11}B(p,αα)^{4}He. At the 440-keV resonance in the first reaction, the γ-α correlation is determined by the amplitude ratio of E2 to M1 radiation. When the transition is to the center of the 2.9-MeV state, the radiation is almost pure M1. The amplitude ratio increases with excitation in ^{8}Be rising to a value of 0.6 ± 0.1 at an excitation of 8 MeV. The reaction ^{11}B(p,αα) was studied at the 670-keV resonance, observing the α particles in coincidence to determine all the kinematical variables. The usual resonance formalism gives a qualitatively satisfactory explanation of the experimental intensities in this reaction. (auth)

26836 ELASTIC SCATTERING OF HEAVY IONS. Gobbi, A.; Matter, U.; Perrenoud, J.-L.; Marmier, P. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Phys., A112: 537-60(1968). (In German).

Angular distributions and excitation functions of the elastic scattering of ^{16}O and ^{12}C on ^{12}O and ^{13}C were measured at incident energies ranging from 10 to 30 MeV. Thin foils of enriched ^{13}C and ^{18}O were used as targets; the reaction products were detected in coincidence. The angular distributions were analysed with the aid of the optical model as well as with various models parametrizing the phase shifts. The scattering of ^{12}C on ^{13}C could only be explained when a contribution of the elastic transfer reaction ^{13}C(^{12}C,^{13}C)^{12}C was added coherently to the elastic potential scattering. In addition, the inclusion of the transfer contribution in the ^{12}C–^{13}C case allowed a determination of the corresponding reduced width of the neutron in ^{13}C. In all the cases investigated, the potential scattering was successfully described by using the smooth cut-off model. (auth)

26837 PROJECTED WAVE FUNCTION FROM THE NILSSON MODEL IN ^{19}F. Hamamoto, Ikuko; Arima, Akito (Tokyo Univ.). Nucl. Phys., A112: 481-93(1968).

The projected wave functions from the Nilsson model are compared with the wave functions obtained by diagonalization of the shell-model Hamiltonian in ^{19}F. The states $(^{1}/_{2})_1$, $(^{3}/_{2})_1$, $(^{5}/_{2})_1$, $(^{7}/_{2})_1$, $(^{9}/_{2})_1$, $(^{11}/_{2})_1$ and $(^{13}/_{2})_1$ belonging to the ground rotational band are found to be projected with very good approximation from one intrinsic state with positive deformation. The intrinsic states with certain negative deformation have effects on some states in this ground state band. The second $(^{5}/_{2})_2$, $(^{7}/_{2})_2$ and $(^{9}/_{2})_2$ states can also be projected from the intrinsic state with negative deformation. The second $(^{1}/_{2})_2$ state can further be projected from another intrinsic state with negative deformation. Overlaps are calculated between the wave functions thus obtained and those given by the shell model. Reasonable values of overlap are found. It is highly desired to observe whether these states have negative deformation. (auth)

26838 ENERGY DEPENDENCE OF p–^{16}O ELASTIC SCATTERING BETWEEN 20 AND 50 MeV AND THE OPTICAL MODEL. Cameron, John Montgomery. Los Angeles, Univ. of California, 1967. 144p.

Thesis.

Differential cross sections for the elastic scattering of protons by oxygen were measured at incident proton energies of 23.4, 24.5, 27.3, 30.1, 34.1, 36.8, 39.7, 43.1, and 46.1 MeV. The data cover the center of mass scattering angles from 10 to 160° and have a relative uncertainty smaller than 2%. An oxygen gas target was bombarded with protons obtained using the variable energy extraction system of the UCLA sector-focused cyclotron. The scattered protons were detected using an array of four NaI(Tl) scintillation counters. The results show strong resonances to exist below 30 MeV which appreciably distort the monotonic energy variation found at the higher energies. The results have been compared with those obtained by other investigators in this energy region. Total reaction cross sections for protons incident on oxygen were measured at energies of 27.2, 34.2, 40.6, and 45.2 MeV using a beam attenuation technique. The results show a slow decrease with increasing energy. A preliminary optical-model analysis of the differential cross-section data, together with polarization data at the same energies, was made in the energy range 30 to 40 MeV using an eleven-parameter optical model search code. This analysis has shown that the model is able to fit the data to large scattering angles with its parameters still retaining a smooth energy dependence. The predictions for the total reaction cross sections were in good agreement with the measurements. (Dissert. Abstr.)

26839 CORE POLARIZATION EFFECTS IN ^{15}O AND ^{15}N. Shukla, A. P.; Brown, G. E. (Princeton Univ., N. J.). Nucl. Phys., A112: 296-328(1968).

The effects of residual interaction are investigated in ^{15}O and ^{15}N. Wave functions of the $^{1}/_{2}^{-}$ and $^{3}/_{2}^{-}$ states are constructed by mixing the single-hole spherical and 2p-3h deformed configurations. The even-parity states are constructed by mixing the 1p-2h and 3p-4h deformed states. The effective charge for the E2 transitions among odd-parity states is calculated by taking account of the contribution of the 2^{+} states of the ^{16}O core. The E2/M1 mixing ratio of the $^{3}/_{2}^{-}$ 6 MeV → $^{1}/_{2}^{-}$ g.s. transition is calculated. Calculated values agree well with experiment. The $^{3}/_{2}^{-}$ 6 MeV → $^{1}/_{2}^{-}$ g.s. transition is found to be predominantly single-hole M1 both in ^{15}O and ^{15}N. The electromagnetic decay of the 5-MeV doublet, 6.79-MeV $^{3}/_{2}^{+}$, 8.29-MeV $^{3}/_{2}^{+}$ and 8.74-MeV $^{1}/_{2}^{+}$ states of ^{15}O is also discussed. The ft value for the ^{15}O → ^{15}N ground-state decay is calculated. It is found to be independent of the deformed admixture in the ground state and is 10% lower than the experimental value. The spectroscopic factors of the $^{1}/_{2}^{-}$ and $^{3}/_{2}^{-}$ states, for single-nucleon pick-up reactions ^{16}O(p,d)^{15}O etc., are also calculated. Agreement with experiment is good for 10% deformed admixture. From this and the calculations of electromagnetic decay of the levels of mass 15, it is concluded that the ground state has a 10% deformed 2p-3h component. (auth)

26840 COULOMB FORM FACTORS OF ^{7}Li. Bouten, M. (SCK-CEN, Mol, Belgium); Bouten, M.-C.; Van Leuven, P. Nucl. Phys., A111: 385-91(1968).

It is shown that the wave functions obtained previously from an approximate projected Hartree–Fock calculation describe accurately the sum of the Coulomb form factors for elastic and inelastic (0.478 MeV) electron scattering, recently determined from experiment. (auth)

26841 GAMMA DECAY OF THE LOWEST T = $^{3}/_{2}$ STATE OF ^{13}N. Dietrich, F. S.; Suffert, M.; Nero, A. V.; Hanna, S. S. (Stanford Univ., Calif.). Phys. Rev., 168: 1169-73(Apr. 20, 1968).

Gamma transitions are observed in the reaction ^{12}C(p,γ)^{13}N from the sharp T = $^{3}/_{2}$ resonance at E_x = 15.07 MeV in ^{13}N to the ground state and to higher excited states. For the ground-state transition, $\Gamma_p\Gamma_\gamma/\Gamma$ = 5.5 ± 0.8 eV. The angular distribution of this transition confirms J^{π} = $^{3}/_{2}^{-}$ for the T = $^{3}/_{2}$ state and gives an amplitude ratio of E2/M1 = −0.095 ± 0.07, in agreement with theory in sign and magnitude. The widths for decay to the ground and excited states are compared with shell-model predictions, and with the analog β transitions in the decay of ^{13}B. (auth)

26842 ISOSPIN-ALLOWED ^{16}O(d,α)^{14}N DIFFERENTIAL CROSS SECTIONS. Jobst, J. E. (Univ. of Wisconsin, Madison). Phys. Rev., 168: 1156-68(Apr. 20, 1968). (COO-7-0421).

Thin (≤13-keV) gas targets have been used for high-resolution studies of isospin-allowed ^{16}O(d,α)^{14}N differential cross sections for 5.0 ≤ E_d ≤ 9.0 MeV. Data were taken at six angles for all α groups corresponding to the ground state of ^{14}N and excited states at 3.945, 4.91, 5.10, 5.69, 6.23, 6.44, 7.03, and 7.97 MeV. Angular distributions at selected energies were also obtained. Additional survey data at 9.0 ≤ E_d ≤ 15.0 MeV were obtained for groups corresponding to the ground state and the 3.945-, 4.91-, and 5.10-MeV excited states at the laboratory angle φ = 14°; curves were also obtained at φ = 166° for the ground-state and 3.945-MeV excited-state groups. There is some evidence for interpreting the observed peaks in the cross section as ^{18}F states. Alternatively, even though the level density of ^{18}F is perhaps marginal, some of the data were subjected to statistical-fluctuation analysis to check the validity of the Γ/D ~ 2 criterion. This analysis yielded an average coherence width Γ of the order of 150 keV. Correlation functions with local averages were also tried to test for possible intermediate structure, with negative results. ^{14}N levels with E_x ≤ 11.51 MeV were observed, but no evidence was found for previously reported levels at 6.05, 6.70, 7.40, and 7.60 MeV. The 2.311-MeV first-excited-state, isospin-forbidden α group was also observed, and these data are being separately reported. (auth)

26843 OPTICAL-MODEL ANALYSIS OF ELASTIC SCATTERING OF ^{3}He PARTICLES BY ^{12}C IN THE RANGE 3.7 TO 15.0 MeV. Park, J. Y. (North Carolina State of the Univ. of North Carolina, Raleigh). Contract AT(40-1)-2624. Nucl. Phys., A111: 433-48(1968). (ORO-3624-3).

Elastic scattering data of ^{3}He particles on ^{12}C at ten energies between 3.7 and 15.0 MeV are analyzed in terms of the optical model. Excellent fits to the measured differential cross sections were obtained using either a five-parameter potential with surface absorption or a four-parameter potential with volume absorption with real and imaginary parts having the same radius and diffuseness. The analysis shows that the optical model gives

a good description for the elastic scattering of ^{3}He particles from such a light nucleus as ^{12}C at the energy range studied, although physical meaning is less clear due to resonance effects. A systematic study of the variation of parameters with energy is carried out. As expected in the light nuclei, it is found difficult to establish a smooth systematic variation of parameters with energy due to resonance effects. Some features of their behavior as a function of energy remain to be explained. However, some general trends are found. Inclusion of the spin-orbit potentials improved the fits considerably in most cases analyzed. Effects of both the volume and surface absorption on the differential cross sections are studied. (auth)

26844 COMPOUND NUCLEUS AND DIRECT EFFECTS IN THE (n,d) REACTION ON ^{19}F AND ^{23}Na AT 14 MeV NEUTRON ENERGY. Fazio, M.; Guazzoni, P.; Micheletti, S.; Pignanelli, M.; Zetta, L. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Nucl. Phys., A111: 255-64(1968).

Differential cross sections for the (n,p) reaction on ^{19}F and the (n,d) reaction on ^{19}F and ^{23}Na were obtained at E_n = 14.1 MeV. The analysis of angular distributions requires both direct and compound nucleus contributions, which were evaluated by DWBA and Hauser–Feshbach theory. The extracted spectroscopic factors were compared with those predicted on the basis of the shell and collective-rotational models. (auth)

26845 ENERGY LEVELS OF ^{16}O IN THE VICINITY OF 13 MeV. Morris, J. M.; Kerr, G. W.; Ophel, T. R. (Australian National Univ., Canberra). Nucl. Phys., A112: 97-116(1968).

Angular distributions and excitation functions of the elastic scattering reaction $^{12}C(\alpha,\alpha_0)$ were analyzed in terms of complex phase shifts for the range of incident alpha particle energies 6.6 MeV $\leq E_\alpha \leq$ 8.5 MeV. The results confirm the presence of four levels in the compound nucleus system ^{16}O at excitation energies of 13.01, 13.08, 13.12, and 13.25 MeV, respectively. Level parameters for the states at 13.01 and 13.12 MeV were deduced with more accuracy than from previous measurements. (auth)

26846 ABSOLUTE CROSS SECTIONS OF THE REACTION $^{16}O(d,p)^{17}O$ AND SPECTROSCOPIC FACTORS OF STATES IN ^{17}O. Naqib, I. M.; Green, L. L. (Univ. of Liverpool). Nucl. Phys., A112: 76-84(1968).

The absolute cross sections of the $^{16}O(d,p)^{17}O$ reaction leading to the ground and 0.87-MeV states in ^{17}O were determined over the deuteron energy range 6.0 to 11.0 MeV. The results indicate that in two previous measurements the absolute cross sections were low by 43 and 32%. DWBA calculations normalized to the present absolute cross sections give values of the spectroscopic factor of the ground and 0.87-MeV state which are close to unity over the entire energy range. Renormalization of previously measured cross sections of stripping to the 5.08-MeV unbound state in ^{17}O results in agreement with calculations which assumed this state to be a single-particle resonance. (auth)

26847 ANGULAR CORRELATION AND LIFETIME MEASUREMENTS IN ^{22}Ne. Kutschera, W.; Pelte, D.; Schrieder, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Heidelberg). Nucl. Phys., A111: 529-50(1968).

The excited states in ^{22}Ne up to 6.68 MeV excitation energy were studied using the $^{19}F(\alpha,p\gamma)^{22}Ne$ reaction at ^{4}He energies of 12.55 and 13.55 MeV. Angular correlations between protons detected at 180° and gamma rays were measured. Possible spin assignments, multipole mixing and branching ratios for the gamma decay from the excited states in ^{22}Ne were obtained. Using a Ge(Li) crystal as gamma-ray detector the values or limits of lifetimes for the 3.35, 4.46, 5.14, and 6.35 MeV states were determined by the analysis of gamma-ray line shapes. The analysis includes the effect on the line shapes due to nuclear scattering. (auth)

26848 THE ANALYSING POWER OF THE REACTION $^7Li(p,\alpha)^4He$ FOR POLARIZED PROTONS FROM 3 to 10 MeV. Plattner, G. R.; Clegg, T. B.; Keller, L. G. (Univ. of Wisconsin, Madison). Contract AT(11-1)-GEN-7. Nucl. Phys., A111: 481-91 (1968). (COO-7-0449).

The analyzing power of the $^7Li(p,\alpha)^4He$ reaction was measured as a function of angle in the energy range between 3 and 10 MeV proton energy. It is found that this reaction is an excellent proton polarization analyzer up to 4.5 MeV and again between 5.5 and 10 MeV. (auth)

26849 NEUTRON WIDTHS IN ^{9}Be. Cocke, C. L.; Christensen, P. R. (California Inst. of Tech., Pasadena). Contract Nonr-220(47). Nucl. Phys., A111: 623-51(1968).

The reaction $^7Li(^3He,p)^9Be(n)^8Be$ was used to measure branching ratios for the neutron decay of ^{9}Be levels at 4.65, 6.76, 11.29, and 11.81 MeV to the ground and first excited states of ^{8}Be. The protons were detected in a surface barrier detector, the neutrons in a plastic scintillator 23 to 102 cm from the target. The neutron flight time was measured using the detection of the associated proton as the time zero. A two-dimensional analysis of neutron flight time versus proton energy was performed. Branching ratios were found to be ^{9}Be(4.65 MeV) to ^{8}Be(g.s.), 13 ± 4%; ^{9}Be(6.76 MeV) to ^{8}Be(g.s.), ≤ 2%; ^{9}Be(11.29 MeV) to ^{8}Be(g.s.), ≤2%; ^{9}Be(11.81 MeV) to ^{8}Be(g.s.), ≤3%; ^{9}Be(11.29 MeV) to ^{8}Be(2^+), 14 ± 4%; ^{9}Be(11.81 MeV) to ^{8}Be(2^+), 12 ± 4%. The branching ratio for ^{9}Be(6.76 MeV) to ^{8}Be(2^+) was found to lie between 41% and 69%. The corresponding reduced widths are found to be in fair agreement with the expectations of the shell model for negative-parity states and with the ^{8}Be + n model of Barker for positive-parity states. (auth)

26850 QUASIELASTIC SCATTERING $^6Li(p,^3He)^3H$ AT 156 MeV. Bachelier, D.; Bernas, M.; Detraz, C.; Radvanyi, P.; Roy, M. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett., 26B: 283-4(Feb. 5, 1968). (In French).

An experiment was performed on the quasielastic scattering $^6Li(p,^3He)t$ at 156 MeV in order to study a ^{3}He + ^{3}H configuration of the nucleus ^{6}Li and to compare it with the stronger α + d configuration. A rather narrow angular correlation distribution was observed, peaked at the angle corresponding to zero momentum for the recoiling triton. (auth)

26851 HEAVY ION TRANSFER REACTIONS WITH IDENTICAL INITIAL AND FINAL STATES. Von Oertzen, W.; Gutbrod, H. H.; Mueller, M.; Voos, U.; Bock, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 26B: 291-4(Feb. 5, 1968).

A special type of transfer reaction which has identical initial and final states and which is strongly localized in angular momentum space is discussed. These reactions A(B,A)B are due to exchange effects in elastic scattering A(B,B)A. Examples for α-particle and proton transfer have been measured and analyzed. (auth)

26852 LIFETIME OF THE FIRST EXCITED STATE OF ^{13}C. Robinson, S. W.; Swann, C. P.; Rasmussen, V. K. (Bartol Research Foundation, Swarthmore, Pa.). Phys. Lett., 26B: 298-300(Feb. 5, 1968).

The mean lifetime of the first excited state of ^{13}C was determined by the nuclear resonant scattering of bremsstrahlung to be 1.5 ± 0.2 fs. This result is in disagreement with a previous Doppler broadening measurement, and in approximate agreement with Morpurgo's prediction for mirror E1 transitions. (auth)

26853 ON THE REACTION $^{12}C(n,n',\gamma)^{12}C$. Braley, R. C. (Lewis Research Center, Cleveland); Nagarajan, M. A.; Gilpatrick, M. W.; Finlay, R. W. Phys. Lett., 26B: 248-9(Feb. 5, 1968).

Measurements of this process are reported and are compared with DWBA calculations made both with and without spin-orbit coupling. (auth)

26854 ON THE MECHANISM OF THE REACTION $^{12}C(\pi^-,\pi^-n)^{11}C$. Dalkarov, O. D. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett., 26B: 610-12(Apr. 15, 1968).

The total cross section of the reaction $^{12}C(\pi^-,\pi^-n)^{11}C$ is calculated taking into account the pole and the triangle diagram. Good agreement with experiment is obtained provided the cross section of the elastic scattering of the isobar Δ_{33} on the ^{11}C nucleus is $\sigma_{el} \approx 3$ mb. (auth)

26855 CALCULATION OF NUCLEAR PROPERTIES WITH EQUIVALENT NONLOCAL NUCLEON–NUCLEON POTENTIALS. Mittelstaedt, P.; Ristig, M.; Roehl, W. H.; Stocker, W. (Univ., Cologne). pp 34 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

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26856 FURTHER RESULTS ON ^{7}He. Stokes, Richard H.; Young, P. G. (Los Alamos Scientific Lab., N. Mex.). pp 41 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

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26857 BOUND STATES AND REACTIONS IN LIGHT NUCLEI. Hackenbroich, H. H.; Wildermuth, K.; Wittern, H. W. (Univ., Tuebingen, Ger.). pp 44 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

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26858 DEFORMATIONS IN ^{6}Li ARISING FROM THE TENSOR FORCE. Freed, N. (Pennsylvania State Univ., University Park); Goldhammer, Paul. pp 46 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

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26859 ON THE BEHAVIOR OF THE WAVE FUNCTION OF THE GROUND STATE OF ^{6}Li. Hasegawa, A.; Nagata, S. (Kyoto Univ.). pp 47 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26860 DEFORMED STATES OF ^{12}C AND ^{14}N. Soga, M. (Bartol Research Foundation, Swarthmore, Pa.). pp 50 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26861 NONNORMAL PARITY STATES IN THE lp-SHELL NUCLEI. Horie, H.; Hsieh, S. T. (Tokyo Inst. of Tech.). pp 51 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26862 EFFECT OF DEGENERACY ON SOLUTION OF BETHE–GOLDSTONE TYPE EQUATION. Suekane, Shota (Osaka City Univ.). pp 57 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26863 ON THE STRUCTURE OF SOME LOW-LYING STATES OF ^{18}O AND ^{18}F. Bhatt, K. H. (Physical Research Lab., Ahmedabad, India); Parikh, J. C. pp 59 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26864 PROTON HOLE STATES IN LIGHT NUCLEI. Jackson, Daphne F. (Univ. of Surrey, London). pp 105 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26865 A VIRTUAL BOUND STATE IN ^{9}Be. Conzett, H. E. (Univ. of California, Berkeley). pp 106 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26866 0^{+} STATES OF ^{8}Be. Barker, F. C.; Hay, H. J.; Treacy, P. B. (Australian National Univ., Canberra). pp 107 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26867 STATES IN ^{9}Be FROM ^{10}B(t,α)^{9}Be. Ajzenberg-Selove, F. (Haverford Coll., Pa.); Wardaski, R. D.; Middleton, R. pp 108 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26868 LOW-LYING STATES OF ^{7}Be STUDIES BY THE ^{7}Li (^{3}He,p)^{9}Be REACTION. Sanada, J.; Liu, Y. C.; Sugiyama, Y.; Mikoshiba, O. (Tokyo Univ.). pp 109 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26869 A STUDY OF THE ^{16}O(d,^{3}He)^{15}N AND ^{16}O(d,t)^{15}O REACTIONS AT 20 MeV. Purser, K. H.; Alford, W. P.; Cline, D.; Fulbright, H. W.; Gove, H. E.; Krick, M. S. (Univ. of Rochester, N. Y.). pp 110 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26870 RADIATIVE TRANSITIONS OF ANALOG STATES IN THE p-SHELL. Fisher, T. R.; Pual, P.; Riess, F.; Thomas, J. B.; Healey, D. C.; Hanna, S. S. (Stanford Univ., Calif.). pp 138 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26871 RADIATIVE CAPTURE OF PROTONS BY ^{11}B ABOVE THE GIANT DIPOLE RESONANCE. Brassard, C.; Scholz, W.; Bromley, D. A. (Yale Univ., New Haven). pp 139 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26872 THE 4.04-MeV ^{13}F STATE. Hirko, R. G.; Lindgren, R. A.; Howard, A. J.; Scholz, W.; Bromley, D. A. (Yale Univ., New Haven). pp 140 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26873 MAGNETIC MOMENT OF ^{12}B. Sugimoto, K.; Nakai, K.; Matuda, K.; Minamisono, T. (Osaka Univ.). pp 196 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26874 STRUCTURE IN ^{16}O + ^{16}O ELASTIC SCATTERING EXCITATION CURVES FOR 35 MeV $\leq E_{LAB} \leq$ 80 MeV. Maher, James; Weidinger, A.; Seimssen, R. H.; Bromley, D. A. (Yale Univ., New Haven). pp 205 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26875 THE REACTION ^{16}O + ^{12}C → ^{18}O + ^{14}C. Goldring, G.; Loebenstein, M.; Plesser, I.; Sachs, M. (Weizmann Inst. of Science, Rehovoth, Israel). pp 206 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26876 ELASTIC SCATTERING OF OXYGEN ISOTOPES ON ^{12}C. Goldring, G.; Loebenstein, M.; Plesser, I.; Sachs, M. (Weizmann Inst. of Science, Rehovoth, Israel). pp 207 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26878 RESIDUAL NUCLEI FROM ^{12}C + ^{12}C REACTIONS AT 87 MeV. Jacmart, J. C.; Liu, M.; Mazloum, F.; Bimbot, L.; Riou, M. (Institut de Physique Nucleaire, Orsay, France). pp 209 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26879 (Li,α) NUCLEAR REACTIONS AND CLUSTER STRUCTURE OF LIGHT NUCLEI. ^{12}C(^{6}Li,α)^{14}N (GROUND) AND ^{12}C(^{6}Li,α) ^{14}N (SECOND) REACTIONS. Honda, T. (Tohoku Univ., Sendai); Horie, H.; Yoshida, H. pp 210 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26880 DWBA ANALYSIS OF THE HEAVY ION-INDUCED TRANSFER REACTIONS. Kammuri, Tetsuo; Yoshida, Hiroshi (Osaka Univ.). pp 211 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26881 PECULIAR FEATURES OF THE PROTON TRANSFER MECHANISM IN REACTIONS WITH HEAVY IONS. Volkov, V. V.; Wilczynski, J. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 212 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26882 LARGE ANGLE SCATTERING OF ^{16}O ON ^{12}C AT 35 MeV. von Oertzen, W.; Gutbrod, H.; Voos, U.; Bock, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 218 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26883 TRITON ELASTIC SCATTERING NEAR 2.0 MeV. Herling, G. H.; Cohen, L.; Silverstein, J. D. (Naval Research Lab., Washington, D. C.). pp 250 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26884 THE STRUCTURE OF ^{6}Li AND ^{7}Li IN EXCITED STATES. Yamashita, S.; Matsuki, S.; Fukunaga, K.; Nguyen, D. C.; Fujiwara, N.; Yanabu, T. (Kyoto Univ.). pp 253 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26885 ALPHA–DEUTERON CLUSTER STRUCTURE FOR ^{6}Li AND ^{6}Li(p,2p)^{5}He REACTION. Saito, Sakae; Hiura, Jun;

Tanaka, Hajime (Hokkaido Univ., Sapporo). pp 254 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26886 INVESTIGATION OF THE ^{9}Be(^{3}He,t)^{9}B REACTION. Nakagawa, T.; Nakagome, Y.; Orihara, H.; Tohei, T.; Ueno, H.; Yamaya, T.; Baba, M. (Tohoku Univ., Sendai). pp 257 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26887 THE ^{6}Li(^{3}He,n$_0$)^{8}B REACTION MECHANISM. McMurray, W. R.; van der Merwe, P.; van Heerden, I. J. (Southern Universities Nuclear Inst., Faure, S. Africa). pp 258 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26889 (t,p) NUCLEAR REACTIONS FOR LIGHT NUCLEI AND NUCLEAR STRUCTURE. Honda, T. (Tohoku Univ., Sendai); Mori, A.; Yoshida, H. pp 260 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26890 QUASI-FREE PROTON–ALPHA AND ALPHA–ALPHA COLLISIONS IN ^{9}Be AND OTHER LIGHT NUCLEI. Yanabu, Y. (Kyoto Univ.); Yamashita, S.; Kakigi, S.; (and others). pp 261 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26891 THE ^{9}Be(t,t)^{9}Be AND ^{9}Be(t,α_0)^{8}Li REACTIONS AT 2.10 MeV. Cohen, L.; Herling, G. H. (Naval Research Lab., Washington, D. C.). pp 262 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26892 INVESTIGATION OF THE ^{9}Be(^{3}He,n)^{11}C REACTION IN THE ENERGY RANGE 3.5 TO 10 MeV. Okano, K.; Kikuchi, S.; Nishimura, K.; Harada, K. (Japan Atomic Energy Research Inst., Tokyo). pp 263 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26893 (p,α) REACTIONS ON LIGHT NUCLEI AT 38 MeV PROTON ENERGY. Gambarini, G.; Iori, I.; Micheletti, S.; Molho, N.; Pignanelli, M.; Tagliaferri, G. (Univ., Milan. INFN, Milan). pp 264 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26895 THE ANTISYMMETRIC TREATMENT OF ^{11}B(d,n)^{12}C IN THE DISTORTED-WAVE BORN APPROXIMATION. Yamaji, S.; Yoshida, H.; Hoshida, S. (Osaka Univ.). pp 266 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26896 RESONANCE AND DIRECT REACTION INTERFERENCE IN (d,p) REACTIONS AT LOW ENERGIES. Beaumevieille, H.; Yaker, M.; Lambert, M. (Institut d'Etudes Nucleaires, Algiers). pp 268 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26897 POLARIZATION OF NEUTRONS FROM THE ^{12}C(d,n$_0$)^{13}N REACTION BELOW 1.8-MeV DEUTERON ENERGIES. Katori, K.; Uchida, A.; Imaizumi, M.; Kobayashi, S. (Tokyo Univ.). pp 269 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26898 (p,p'), (p,d), AND (p,t) REACTIONS ON ^{12}C AT 54.9 MeV. Taketani, Hiroshi (Tokyo Inst. of Tech.); Yamaguchi, Hisashi; Kokame, Jun; Muto, Jiro. pp 270 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26899 STUDY OF THE ^{12}C(t,α_0)^{11}B REACTION BY 1.5- TO 3.2-MeV TRITONS. Seltz, R.; Wery, M.; Gerardin, C.; Magnac-Valette, D. (CRN, Strasbourg). pp 271 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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See CONF-670910.

26901 ALPHA-PARTICLE ANGULAR DISTRIBUTIONS FROM ^{13}C(^{3}He,α)^{12}C REACTION. Mikumo, T.; Seki, S.; Tagishi, Y. Tokyo Univ. of Education). pp 275 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26902 CORE EXCITATION OF LIGHT ODD NUCLEUS BY (d,p) REACTION. Kakigi, S.; Hosono, K.; Nakamura, H.; Nguyen, D. C.; Fujiwara, N.; Yanabu, T. (Kyoto Univ.). pp 276 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26903 (p,d) AND (p,t) REACTIONS ON ^{13}C AT 54.9 MeV. Taketani, Hiroshi (Tokyo Inst. of Tech.); Muto, Jiro; Yamaguchi, Hisashi; Kokame, Jun. pp 277 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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26904 ELASTIC AND INELASTIC SCATTERING OF PROTONS BY ^{14}N. Oda, Y.; Takeda, S.; Wada, T.; Igarashi, M.; Murakami, M. (Tokyo Inst. of Tech.). pp 278 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26905 MEASUREMENTS AND DWBA ANALYSES OF SOME 13.9-MeV DIFFERENTIAL CROSS SECTIONS FOR THE ^{14}N(^{3}He,α)^{13}N REACTIONS. Lucas, B. T.; Ober, D. R.; Johnson, O. E. (Purdue Univ., Lafayette, Ind.). pp 279 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26906 SCATTERING OF ALPHA PARTICLES BY LIGHT EVEN–EVEN NUCLEI. Takeda, Minoru; Kato, Syohei; Yamazaki, Takashi (Osaka Univ.). pp 280 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26907 ENERGY DEPENDENCE OF p–^{16}O ELASTIC SCATTERING BETWEEN 20 AND 50 MeV AND THE OPTICAL MODEL. Cameron, J. M.; Carlson, R. F.; Eldridge, H. B.; Richardson, J. Reginald; van Oers, W. T. H.; Verba, J. W. (Univ. of California, Los Angeles). pp 281 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26908 STUDY OF FEW NUCLEON PICKUP PROCESSES ON ^{19}F. Cole, Robert K. (Univ. of Southern California, Los Angeles); Huber, Kent A.; Waddell, Charles N.; Dittman, Roger R.; Dickens, J. K. Contract AT(04-3)-136. pp 283 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967. (USC–136-123).
See CONF-670910.

26909 SEARCH FOR T = $^{3}/_{2}$ STATES IN ^{13}N. LeVine, M. J.; Parker, P. D. (Yale Univ., New Haven). pp 317 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26910 CARBON–ALPHA SCATTERING FROM 18 TO 28 MeV. Morgan, James F.; Hobbie, R. K.; Hintz, N. M. (Univ. of Minne-

sota, Minneapolis). pp 341 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26911 ELASTIC AND INELASTIC SCATTERING OF 70 TO 1200 MeV ELECTRONS BY LIGHT AND HEAVY NUCLEI. Afanasev, N. G.; Goldstein, V. A.; Startsev, V. I.; (and others) (Physical-Technical Inst., Kharkov). pp 366 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

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See CONF-670910.

26913 ON THE PHOTONUCLEAR REACTIONS OF ^{6}Li. Oda, Y.; Hirabayasi, H.; Fujioka, K. (Tokyo Inst. of Tech.). pp 374 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26914 GIANT DIPOLE RESONANCES IN p-SHELL NUCLEI. Black, J. L.; Riess, F.; Paul, P.; O'Connell, W. J.; Fisher, G. A.; Hanna, S. S. (Stanford Univ., Calif.). pp 375 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26915 MUON CAPTURE RATE IN ^{12}C WITH EXACT NUCLEAR AND MUON WAVE FUNCTIONS. Hirooka, M. (Osaka Univ.); Konishi, T.; Morita, R.; Narumi, H.; Soga, M.; Moritâ, M. pp 408 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26916 ON THE π-NUCLEUS INTERACTION. Nguyen-Trung, C. (Kyoto Univ.); Tohsaki, A.; Sakamoto, Y. pp 412 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26917 EFFECTS OF SOFT-CORE POTENTIAL ON STOPPED π^- MESON ABSORPTION. Cheon, Il-T. (Kyoto Univ.). pp 414 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26918 $(\gamma,p\gamma)$ AND $(\gamma,n\gamma)$ REACTIONS ON ^{16}O. Murray, K. M.; Ritter, J. C. (Naval Research Lab., Washington, D. C.). pp 383 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26919 DECAY MODES OF ^{16}O GIANT RESONANCE STATES. Baglin, J. E. E.; Thompson, M. N. (Yale Univ., New Haven). pp 388 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26920 PRODUCTION OF ^{11}C AND ^{7}Be FROM ^{12}C BY HIGH-ENERGY PHOTONS. di Napoli, V. (Univ., Rome); Dobici, F.; Salvetti, F.; Forina, O.; de Carvalho, H. G. pp 389 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26921 PHOTONUCLEAR REACTIONS OF TYPE (γ,t) AND $(\gamma,n\alpha)$ WITH BREMSSTRAHLUNG UP TO 55 MeV. Buttlar, H. v.; Goldmann, A.; Huber, B.; Kraemer, K. (Technishce Hochschule, Darmstadt, Ger.). pp 390 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26922 CORRECTIONS TO ELECTROMAGNETIC TRANSITION RATES DUE TO GROUND-STATE CORRELATIONS. Da Providencia, J.; Shakin, C. M. (Massachusetts Inst. of Tech., Cambridge). pp 391 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26923 CALCULATION OF CONTINUUM STATE AND NUCLEAR PHOTOEFFECT. Fujii, S. (Nihon Univ., Tokyo). pp 392 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26924 MUONIC AND PIONIC X-RAY SPECTRA. Backenstoss, G.; Charalambus, S.; Daniel, H.; Koch, H.; Poelz, G.; Schmitt, H.; Tauscher, L. (CERN, Geneva. Max-Planck-Institut fuer Kernphysik, Heidelberg. Technische Hochschule, Karlsruhe, Ger.). pp 409 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

26925 THE BREAKUP OF ^{12}C AT 26-MeV EXCITATION. Pecka, Dusan Charles. Pullman, Wash., Washington State Univ., 1967. 63p.
Thesis.

Differential cross sections for the reaction ^{10}B(d,d)^{10}B were measured at a laboratory angle θ_{LAB} = 156° for deuteron bombarding energies between 900 and 1150 keV. The peak at E_d = 980 keV is attributed to a state in ^{12}C corresponding to an excitation energy of 26.00 ± .01 MeV. The decay of the 26-MeV level in ^{12}C into three alpha particles was examined in a plane perpendicular to the beam direction. A study of the coincidence spectra obtained with two silicon surface-barrier detectors suggests primarily sequential breakup through the ^{8}Be(2.9), ^{8}Be(g.s.) and to a smaller extent through the ^{8}Be(11.4) state. Assuming that the 26-Mev level is formed by s-wave deuterons, an angular correlation analysis of the α-α cascade proceeding through the ^{8}Be(2.9) state was carried out. The results indicate that 2^+ and 4^+ are possible spin and parity assignments for the ^{12}C state, whereas the 3^+ assignment does not appear to be consistent with the observed correlation. (Disser. Abstr.)

26926 APPLICATION OF THE PARTICLE-HOLE MODEL TO ELECTROEXCITATION AND MUON CAPTURE IN LIGHT NUCLEI. Hill, Lemmuel LeRoy Jr. Washington, D. C., Catholic Univ. of America, 1967. 128p.
Thesis.

Results were obtained for each of the five, light, magic number, nuclei ^{12}C, ^{16}O, ^{28}Si, ^{32}S, and ^{40}Ca. In the framework of the one-particle, one-hole model with a Serber residual interaction the negative-parity J = 0, 1, and 2, T = 1 eigenstates are calculated. These results are then used to determine the E1 and M2 squared reduced matrix elements for inelastic electron scattering for values of momentum transfer from 0 to 300 MeV/c. The nucleon decay widths of the 1^- and 2^- states are calculated from R-matrix theory and are used in conjunction with the E1 and M2 matrix elements and the Breit-Wigner formula to determine the excitation spectra for photonuclear and 180° electron inelastic scattering reactions. In addition the matrix elements for muon capture are calculated for all three couplings, and the total muon capture rate is determined. Comparison of the many results with other calculations and with experimental data, where possible, is in general good in the case of ^{12}C, ^{16}O, and ^{40}Ca and fair for ^{28}Si and ^{32}S. The excitation spectra demonstrate that while inelastic electron scattering at 180° can be a powerful tool to investigate nuclear structure, this study must be made through a consideration of the M2 transitions since for electron energies above about 50 MeV they dominate the low-energy region (12 to 18 MeV) of the excitation spectra while the E1 transitions are responsible for most of the structure at high energies (20 to 40 MeV). Muon capture rate predictions are in excellent agreement with experimental results for ^{12}C but the agreement degrades with mass number and in ^{40}Ca the predicted value is 77% higher than the experimental value. (Diss. Abstr.)

26927 STUDY OF METHODS FOR CALCULATING THE SPIN-ORBIT DOUBLET SPLITTING IN ^{17}O. Niblack, Walter Kenneth. Buffalo, N. Y., State Univ. of New York, 1967. 150p.
Thesis.

An attempt was made to develop improved methods for calculating the properties of light nuclei, using as a starting point the assumption that they consist of a known number of nucleons interacting by means of a known two-body potential. The pioneering work of Brueckner, et. al., and Bethe and Goldstone, applied to nuclear matter, showed the usefulness of the K-matrix approach, and proved that the "hard-core" which was needed to fit the high-energy scattering data was also required to achieve a reasonable value for the density of nuclear matter. The nuclear matter calculations, however, provide no evidence to corroborate the need for a spin-orbit term in the phenomenological two-body force law and did not provide any thoroughly satisfactory method for calculating the K-matrix in the presence of a hard-core interaction. The above approach also raises difficulties when applied to nuclei of finite radius, since it is based on the use of infinite plane waves as basis states. In this dissertation, the three-dimensional har-

monic oscillator wave functions are used as basis states; first, because they give a reasonable approximation to the properties of light nuclei (in the sense of shell theory), and secondly, because they admit of separation into center-of-mass and relative coordinates as pointed out by Talmi. Two approaches are investigated. The first involves the solution of the equation for the motion of two nucleons in a common harmonic oscillator well, interacting by means of a hard core only. Having obtained these solutions, the hard core can be dropped from the interaction, the distorted wave functions being calculated either by calculating the K-matrix from the integral equation K = V + VGK, or by the use of the perturbation expansion of this equation. This method is illustrated by calculating the spin-orbit splitting in ^{17}O, using the phenomenological potential of Gammel and Thaler, with results in close agreement with the experimental value of 5.1 MeV. Most of the splitting results from the combined action of the hard-core and the two-body spin-orbit force. The second method circumvents the hard-core problem, and also the usual expansion of the K-matrix into terms of various orders in the potential, V, by use of a new method for approximating particular eigenvalues and eigenfunctions of a Hamiltonian. This method converges even when the off-diagonal (interaction) terms are large. Using this technique, with the hard core approximated as a large, but finite potential extending from r = 0 to r = r_{core}, the distortion of the wave functions (the effect of the K-matrix on the original wave functions) may be calculated to any desired precision. (Diss. Abstr.)

26928 ANGULAR CORRELATION MEASUREMENTS ON $^{11}B(d,p\gamma)^{12*}B(0.95)$ TO TEST SYSTEMATICS OF DEUTERON STRIPPING. Borden, Andrew Pitman. Charlottesville, Va., Univ. of Virginia, 1967. 100p.

Thesis.

Angular correlations (p-γ) from $^{11}B(d,p\gamma)^{12*}B(0.95)$ were measured in order to test the character of the (d,p) reaction mechanism under variations in the distance (D) to the pole for deuteron stripping. Angular distribution measurements on this reaction have previously been shown to be characterized by an approximately constant $D = D(E_d, \theta_{dp})$, below which the distribution data can be fit by PWBA theory and above which PWBA theory fails to fit. The interpretation of this result has been subject to controversy concerning the level of distortion effects. Correlation measurements provide more detailed information bearing on these questions. Ten reaction plane angular correlations were measured in the deuteron energy range 1.0 to 5.5 MeV. The correlation symmetry axis positions were found to systematically tend toward PWBA predictions for decreasing D but the anisotropies failed to follow this trend. This is taken as evidence that distortions are not systematically reduced as D is lowered. It is not clear that a reduction of Coulomb distortions is theoretically expected as D gets lower and it appears more realistic to expect the correlation parameters to converge on CWBA (Coulomb Wave Born Approximation) predictions. CWBA calculations are not presently available for comparison with this data, but preliminary DWBA calculations are not significantly better than PWBA results in accounting for the observed correlation parameters. Under the assumption that DWBA stripping theory is applicable, the ratio of reduced widths for neutron capture $x = \theta_s^2/\theta_s^2$ has been shown to be positive and bounded as $0.1 < x < 8$. (Disser. Abstr.)

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Refer also to abstracts 25441, 26739, 26766, 26792, 26832, 26844, 26855, 26857, 26881, 26890, 26906, 26911, 26924, 26926, 27086, 27119, 27122, 27140, 27141, 27158, 27168, 27191, 27193, 27210, 27217, 27234, 27241, 27247, 27253, 27262, 27268, 27270, 27273, 27278, 27301, 27302, 27305, 27306, 27364, 27367–27369, 27376, and 27379–27381.

26929 (COO-1420-139) RESEARCH IN NUCLEAR PHYSICS. Final Report, October 1, 1964–September 30, 1967. Steffen, R. M. (Purdue Univ., Lafayette, Ind. Dept. of Physics). Mar. 29, 1968. Contract AT(11-1)-1420. 90p. Dep. CFSTI.

Some experimental investigations of nuclear levels by α reactions and scattering and by β decay are summarized, including several β-γ and γ-γ directional correlation studies. The development of computer programs for analyzing the nonrelativistic kinematics of the two- and three-body final-state reactions, for calculating conversion coefficients and particle parameters, for calculating the thickness of targets from energy-loss measurements, and for analyzing angular correlation data is also reported. Some developments in instrumentation, including methods for fabricating Ge(Li) detectors, are also summarized. (D.C.W.)

26930 (GA-8496) RADIATION WIDTH OF THE 2.85-keV LEVEL IN ^{23}Na. Friesenhahn, S. J. (Gulf General Atomic, Inc., San Diego, Calif.). Jan. 31, 1968. Contract AT(04-3)-167. 11p. (CONF-680307-32). Dep. CFSTI.

From 2nd Conference on Neutron Cross Sections and Technology, Washington, D. C.

Knowledge of the sodium cross section in the keV region is of prime importance because of its use as a coolant in fast breeder reactors. The total cross section of sodium has been thoroughly investigated; however, with the exception of the thermal region, little data exist on the capture cross section. Recent measurements of the radiation width of the 2.85-keV resonance have led to results that are difficult to reconcile with the thermal capture cross section. Measurements have been performed in an attempt to resolve this discrepancy. Preliminary results have yielded the radiation width (0.34 eV) expected from the thermal capture cross section and the capture yield is consistent with that expected from a single level. Since the neutron width is more than one thousand times larger than the radiation width, this level presents a severe test of the methods used to measure capture areas and to calculate the effects of multiple scattering. The results from the three investigators are compared, and the discrepancies are discussed in an attempt to expedite future capture measurements on very strong levels. (auth)

26931 (LYCEN-6789) ETUDE COMPAREE DES REACTIONS (D,^{3}He) ET (D,T) SUR QUELQUES NOYAUX AVEC N = Z. (Comparative Study of (d,^{3}He) and (d,t) Reactions on Some Nuclei With N = Z). Gaillard, Michel (Lyon Univ. (France). Institut de Physique Nucleaire). Dec. 1967. 173p. (In French). Dep.

Thesis.

The angular distributions of the (d,^{3}He) and (d,t) reactions were studied at 28 MeV on the Z = N nuclei ^{10}B, ^{12}C, ^{14}N, ^{16}O, ^{28}Si, ^{32}S, and ^{40}Ca. In order to interpret these results by the distorted-wave method, the elastic scattering cross section (d,d) was also measured. The experimental results indicate that the structure of the angular distributions of the ^{3}He and tritons on the same target nucleus is similar. It is a very pronounced oscillatory structure, suggesting in part that a direct reaction mechanism is preponderant and in part that the mechanism is the same for the two types of reactions. The experimental results indicate that the effect of the reaction Q is shown in the following manner: the angular displacement between the ^{3}He and triton distributions increases with the difference ΔQ between the two reaction heats. This difference, due to the different binding energies of the residual nuclei, is responsible for an inequality between the output energies of the ^{3}He and triton. For the reaction couples studied, ΔQ increases almost linearly with the mass and charge of the target nucleus. If the differential cross sections for (d,^{3}He) and (d,t) are equal for ^{10}B, ^{12}C, and ^{14}N, the amplitudes become unequal and more and more different as one goes from A = 16 to A = 40. (J.S.R.)

26932 (NP-17434) ANNUAL REPORT [ON NUCLEAR RESEARCH], FOR THE YEAR ENDING DECEMBER 1967. McMurray, W. R. (comp.) (Southern Universities Nuclear Inst., Faure (South Africa)). 1967. 70p. Dep.

A number of investigations of charged-particle reactions and scattering and of neutron scattering are summarized, together with the information that was obtained on level schemes. Developments in instrumentation and in methods of activation analysis, including measurements of activation cross sections, are also reported. (D.C.W.)

26933 ANALYSIS OF FLUCTUATIONS IN THE $^{27}Al(p,\alpha)^{24}Mg$ EXCITATION FUNCTIONS FROM 10.9 TO 19.7 MeV. Put, L. W.; Roeders, J. D. A.; van der Woude, A. (Rijksuniversiteit, Groningen, Netherlands). Nucl. Phys., A112: 561-82(1968).

Excitation functions for the $^{27}Al(p,\alpha)^{24}Mg$ reaction were measured at four angles. The proton energy was varied from 10.9 to 19.7 MeV in steps of 25 keV. For the fluctuation analysis, the autocorrelation and peak-counting methods were applied. In view of non-statistical variations in the cross sections, the sliding-average method was used. The biases in Γ and C(0) due to the use of the sliding-average method were obtained with calculations from synthetic excitation functions. There is some evidence for modulations in the excitation functions. The characteristic width of these modulations varies between 400 and 1000 keV. For excitation energies from 22.1 to 30.6 MeV, the value of Γ increases from about 55 keV to about 80 keV. (auth)

26934 ISOMERIC CROSS-SECTION RATIOS AND TOTAL CROSS SECTIONS FOR THE REACTIONS $^{59}Co(n,2n)^{58g,m}Co$, $^{58}Ni(n,p)^{58g,m}Co$, and $^{56}Co(\gamma,n)^{55g,m}Co$. Decowski, P.; Grochulski, W.; Marcinkowski, A.; Siwek, K.; Sledzinska, I.; Wilhelmi, Z. (Univ. of Warsaw. Inst. of Nuclear Research, Warsaw). Nucl. Phys., A112: 513-26(1968).

The isomeric ratios and excitation functions were measured for the $^{59}Co(n,2n)^{58}Co$ reaction in the neutron energy range 12 to 18

MeV and for the ^{58}Ni(n,p)^{58}Co reaction in the neutron range 2 to 18 MeV. The isomeric ratio is also presented for the ^{59}Co(γ,n)^{58}Co reaction induced by photons from 30-MeV electron bremsstrahlung. The results are compared with the statistical-model predictions. Use was made of modified nuclear level density formulae based on the superconductivity theory, which account for the pairing and shell effects. In all cases investigated, the calculated isomeric ratios show good agreement with experimental data, whereas the calculated total cross sections do not agree with the measured values. The disagreement may be due to the fact that no account was taken of the gamma emission in competition with the neutron emission from the residual nucleus. (auth)

26935 THERMAL NEUTRON ACTIVATION CROSS SECTIONS FOR THE ISOMERIC STATES IN ODD INDIUM ISOTOPES AND THE j-SELECTION RULE. Alexander, K. F.; Brinckmann, H. F.; Heiser, C.; Neubert, W. (Deutsche Akademie der Wissenschaften, Berlin. Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys., A112: 474-80(1968).

The thermal neutron activation cross sections for the two isomeric states in ^{114}In were measured using a 2π flow counter for the long-lived and the pulsed activation method for the short-lived isomer. The values obtained are $\sigma_{act} = 7.5 \pm 0.7$ b for ^{114m}In (49 d) in agreement with a value measured by Keisch, and $\sigma_{act} = 3.1$ b for ^{114m}In (42 msec). The isomeric cross-section ratios were analyzed using the statistical approach of Huizenga and Vandenbosch. It follows that both isomeric states should have the same spin value 5, in spite of the fact that they are connected by a pure E3 transition. The same situation prevails in ^{116}In. Possible explanations are E1 and M2 transitions are so strongly hindered that they are in fact completely suppressed; and the statistical approach in evaluating isomeric cross-section ratios breaks down because of the channellizing action of the $(g_{\frac{9}{2}}^{-1})_p (h_{\frac{11}{2}})_n$ multiplet which directs the gamma-ray cascade to its member with the lowest excitation energy (i.e. the isomeric state). Both explanations are founded on the action of the j-selection rule, which forbids transitions of low multipole order between the configurations $[(g_{\frac{9}{2}}^{-1})_p (h_{\frac{11}{2}})_n]1^- \ldots 10^-$ and $[(g_{\frac{9}{2}}^{-1})_p (s_{\frac{1}{2}} + d_{\frac{3}{2}})_n]\, 4^+, 5^+$. (auth)

26936 PROPERTIES OF SOME EXCITED STATES OF ^{25}Mg. Sowerby, B. D.; McCallum, G. J. (Australian National Univ., Canberra). Nucl. Phys., A112: 453-73(1968).

Investigation of the electromagnetic transitions in ^{25}Mg has led to the determination of the following parameters: the branching ratios of the third to eighth excited states inclusive: the multipole mixing ratios of the 1.960 → 0, 1.960 → 0.975 and 3.400 → 1.614 MeV transitions; the spins and parities of the 1.614-, 2.738-, and 3.400-MeV levels and the lifetime of the 3.400-MeV level. The experimental results are compared with the corresponding results in the mirror nucleus ^{25}Al, and experimental information is presented relating to the rules governing the strength of corresponding transitions in mirror nuclei. The experimental results are also compared with the predictions of the strong-coupling rotational model. (auth)

26937 LEVELS OF ^{48}V FROM THE ^{47}Ti(^{3}He,d)^{48}V REACTION. Dorenbusch, W. E.; Belote, T. A.; Rapaport, J.; Nair, K. G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nucl. Phys., A112: 385-98(1968). (MIT-2098-420).

The reaction ^{47}Ti(^{3}He,d)^{48}V was investigated at an incident energy of 11.0 MeV. Deuteron angular distributions were measured in the MIT multiple-gap spectrograph and were analyzed using the distorted-wave Born approximation. Transitions were observed to the analogues of the ground state and first excited state of ^{48}Ti and the ^{48}V–^{48}Ti Coulomb energy difference was determined to be $\Delta E_C = 7.838 \pm 0.020$ MeV. The present results are compared with those of previous experiments on ^{48}V and with those for odd-mass vanadium isotopes. (auth)

26938 BETA- AND GAMMA-RAY MEASUREMENTS ON THE DECAY OF ^{38}Cl. Van Klinken, J.; Pleiter, F.; Dijkstra, H. T. (Univ., Groningen, Netherlands). Nucl. Phys., A112: 372-84(1968).

The decay of 37-min ^{38}Cl was reinvestigated with improved methods and accuracy. It was shown that the β-ray transition to the ground state of ^{38}Ar has a unique shape. This confirms the theoretical predictions that the ground state of ^{38}Cl is 2^- and removes a contradiction arising from earlier measurements. After correction for the unique shape, the residual shape factor 1 + aW is found to be close to one: $a = -0.005 \pm 0.004$. This result must be compared with other measurements of unique transitions, which often give more pronounced negative values for a. The observed end-point energy is $E_{max}(\beta_0^-) = 4913 \pm 5$ keV. A comparative shape measurement with ^{42}K yielded: $a = -0.005 \pm 0.003$, $E_{max}(\beta_0^-) = 3519 \pm 4$ keV. The energies of the three known γ-ray transitions were measured with a 20 cm^3 Ge(Li) detector; γ_1: 1642.16 ± 0.13 keV (73.8 ± 0.9); γ_2: 2167.60 ± 0.16 keV (100) and γ_3: 3810 ± 2 keV (0.061 ± 0.005), with relative intensities given in parentheses. In an appendix, the assignment $\frac{1}{2}^-$ to ^{35}Y resulting from the use of ^{36}Cl for calibration is mentioned. (auth)

26939 SPECTROSCOPY OF ^{49}V AND ^{51}V WITH (^{3}He,d) REACTION AT 10 MeV. Maheshwari, P. N.; St-Pierre, C.; Doutriaux, D. (Laval Univ., Quebec). Nucl. Sci. Appl., 3: 16-21 (Oct. 1967).

The (^{3}He,d) reaction on targets of enriched isotopes of ^{48}Ti and ^{50}Ti was studied at 10-MeV bombarding energy. The deuteron energy spectra were recorded with solid-state detectors using particle identification at 22 and 26 angles for ^{48}Ti and ^{50}Ti targets, respectively, ranging from 15 to 120°. Levels in ^{49}V and ^{51}V were observed up to 4.49 and 4.25 MeV excitation, respectively; and angular distributions were extracted for more strongly excited or well isolated states. The elastic scattering of 10-MeV ^{3}He on ^{48}Ti and ^{50}Ti was also measured. The values of the orbital angular momenta of the transferred protons and transition strengths were derived from the experimental measurements and from calculations using zero-range distorted-wave Born approximation analysis. (auth)

26940 ANALOG STATES THROUGH THE ^{34}S(p,γ)^{35}Cl REACTION. Manthuruthil, J. C.; Lee, F. D.; Watson, D. D. (Wright-Patterson AFB, Ohio). Nucl. Sci. Appl., 3: 44-50(Oct. 1967).

The γ-ray yield from the reaction ^{34}S(p,γ)^{35}Cl shows strong resonances at proton energies of 1214 keV, 1512 keV, and a strong doublet at 1900 and 1906 keV. These resonance states occur at the correct energies to be isobaric analogs of the 1.99-, 2.35-, and 2.71-MeV states in ^{35}S. Angular distributions, triple correlations, and polarization measurements have been performed at each of these resonances. The 1214-keV resonance, which corresponds to an excitation energy of 7.54 MeV in ^{35}Cl, has spin and parity of $\frac{1}{2}^-$ and decays almost entirely to the 3.16-MeV level which was also found to have spin and parity of $\frac{1}{2}^-$. The transition is pure M1 and has a measured strength of 1.6 Wu. The 1512-keV resonance, which corresponds to an excitation energy of 7.84 MeV, has spin and parity $\frac{3}{2}^-$ and decays strongly to the 4.17-MeV level which was found to be a $\frac{3}{2}^-$ state. This transition is also pure M1 with a strength of 1.0 Wu. The value of θ_p^2 is greater than 0.2 for both of these resonances. Both members of the doublet at 1900 keV have spins of $\frac{5}{2}$. The reduced widths of the resonance at 1214 keV and 1512 keV are nearly equal in value to the $\theta_p^2 = \frac{1}{3}$ calculated for pure single particle $f_{\frac{7}{2}}$, $T = \frac{3}{2}$, and $p_{\frac{3}{2}}$, $T = \frac{3}{2}$, respectively. This agrees with the large (d,p) stripping width of the analog states at 1.99 and 2.35 MeV in ^{35}S. The analog state at 1900 keV appears to be split due to mixing with a nearby $T = \frac{1}{2}$ state of the same spin and parity. The levels at 3.16 and 4.17 MeV appear to be of the same configuration as their corresponding resonance states but to differ only in isobaric spin, having $T = \frac{1}{2}$. Values for the reduced widths, energies, isobaric spin splitting of the $T_>$ and $T_<$ states, as well as the M1 transition speeds assuming pure single nucleon states were calculated and are in good agreement with observed values. (auth)

26941 GAMMA RAYS FOLLOWING NEUTRON INELASTIC SCATTERING FROM ^{51}V. Siddiq, A. K. M. (Dacca Univ., Pakistan); Afsaruddin; Islam, Nurul; Yunus, Iqbal. Nucl. Sci. Appl., 3: 70-3(Oct. 1967).

The energy levels of ^{51}V were studied by measuring gamma rays following neutron inelastic scattering. Levels were observed at 320 ± 5 and 930 ± 10 keV. The observed 620 ± 10-keV gamma ray appears to originate from cascade transition from the second excited state to the first excited state in ^{51}V. The angular distributions of the 320-keV gamma ray were measured at $E_n = 540$, 680, and 785 keV. The distributions are either isotropic or depart slightly from isotropy. The relative yield of the same gamma ray was also measured as a function of neutron energy up to 1 MeV. The cross sections for the 320-keV gamma-ray transition were measured to be 600 and 340 mb at $E_n = 1.18$ and 1.94 MeV, respectively, within an accuracy of ±25%. (auth)

26942 DECAY OF ^{83}Rb. Aras, N. K.; Eichler, E.; Chilosi, G.; O'Kelley, G. D.; Johnson, N. R. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Appl., 3: 58-63(Oct. 1967).

The decay of 18-min ^{83}Rb was investigated using a lithium-drifted germanium detector for singles spectra and two NaI detectors addressing a two-parameter analyzer for coincidence measurements. Since ^{83}Rb decays with high-energy gamma rays, a pair spectrometer was also used. Gamma rays (and intensities) were observed at 899 (64.3), 1371 (6.2), 1449 (–), 1837 (100), 2116 (3.0), 2390 (0.3), 2574 (1.5), 2676 (12.3), 2736 (0.4), 3010 (1.6), 3218 (1.3), 3485 (0.8), 4023 (0.1), 4738 (0.8), and 4850 (0.1) keV. These results, combined with the coincidence data, lead to ^{83}Sr levels at 1837, 2574, 2736, 3218, 3485, 4023, 4227, 4513, 4738, and 4850 keV. On the basis of gamma-ray intensities, beta-ray intensities and possible spin and parity values of the levels in ^{83}Sr were predicted. (auth)

26943 (^{3}He,α) REACTIONS FROM NICKEL AND ZIRCONIUM ISOTOPES. Rundquist, D. E.; Brussel, M. K.; Yavin, A. I. (Univ. of Illinois, Urbana). Phys. Rev., 168: 1296-1311 (Apr. 20, 1968).

The stable isotopes of nickel and zirconium, with the exception of ^{96}Zr, were irradiated with a 25-MeV ^{3}He beam. Absolute cross sections for (^{3}He,α) reactions were measured. The (^{3}He,α) angular distributions for l transfers of 1 and 3 were found to contain some J-dependent effects, especially in the lighter isotopes of nickel. Distorted-wave Born-approximation (DWBA) predictions for all of the measured angular distributions are presented. Corrections for finite-range nonlocal potential were included in the DWBA calculations by use of the local-energy approximation. Spectroscopic factors were extracted. Some discussion on the merits of the (^{3}He,α) reaction as a general nuclear spectroscopic tool is presented. (auth)

26944 ANALYSIS OF THE ^{54}Fe(^{3}He,α)^{53}Fe REACTION. Trier, A.; (Univ. Chile, Santiago); Gonzalez, L; Rapaport, J.; Belote, T. A.; Dorenbusch, W. E. Contract AT(30-1)-2098 Nucl. Phys., A111: 241-54(1968). (MIT-2098-416).

The ^{54}Fe(^{3}He,α)^{53}Fe reaction was investigated at an incident ^{3}He energy of 13.0 MeV. A ground-state Q-value of 7.197 ± 0.020 MeV was measured for this reaction. Alpha-particle spectra were obtained at lab angles between 7.5 and 165.0°. A distorted-wave analysis of the data was carried out to obtain l_n values and spectroscopic strengths. Isobaric analog states were observed at excitation energies of 4.256, 7.037, and 7.267 MeV corresponding to the ground state of ^{53}Mn and to the $2s_{\frac{1}{2}}$ and $1d_{\frac{3}{2}}$ hole states in ^{53}Mn. The results are compared with other experimental data and with theoretical predictions. (auth)

26945 ANGULAR DISTRIBUTION OF PROTONS FROM (d,p) REACTIONS IN ^{56}Fe. Kahn, A. H. (Atomic Energy Centre, Dacca, Pakistan); Hossain, A.; Sen Gupta, H. M.; Hannan, A. H. M. A. Nucl. Sci. Appl., 3: 51-7(Oct. 1967).

Energy levels in ^{57}Fe were studied by (d,p) reactions in ^{56}Fe; the results are compared with previous data. Angular distributions for 26 levels are given, and the results are analyzed in terms of the Butler stripping process. (auth)

26946 ELASTIC AND INELASTIC SCATTERING OF 155-MeV PROTONS BY ^{24}Mg, ^{28}Si, ^{32}S, AND ^{40}Ca. Willis, A.; Geoffrion, B.; Marty, N.; Morlet, M.; Rolland, C.; Tatischeff, B. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A112: 417-42(1968). (In French).

The 2s-1d shell nuclei ^{24}Mg, ^{28}Si, ^{32}S, and ^{40}Ca were studied by elastic and inelastic scattering of 155-MeV protons. Cross sections and polarizations were measured. An optical-model analysis was performed on the elastic scattering results. The inelastic scattering was interpreted with the DWIA method. The results of these calculations are in general agreement with experiment, but they need some improvement to be quite correct. Cross sections of the (d,p) reactions with 155-MeV protons and (d,p), (d,t) and (d,^{3}He) reactions with 82-MeV deuterons were measured on ^{27}Al and ^{28}Si targets; the results are discussed on the basis of Ripka's model. (auth)

26947 ELECTROMAGNETIC DE-EXCITATION OF THE 4.51-MeV LEVEL OF ^{48}Ca. Gorodetzky, S. (Institut de Recherches Nucleaires, Strasbourg); Britz, J.; Chevallier, P.; Rabin, B.; Sutter, G.; Drouin, R. J. Phys. (Paris), 29: 135-7 (Feb.-Mar. 1968). (In French).

The electromagnetic de-excitation modes of the 4.51 MeV level of ^{48}Ca were studied by means of the ^{48}Ca(p,p')^{48}Ca reaction. The results obtained show that the experimental ratio $\Gamma_{4.51\ MeV \to 3.83\ MeV}/\Gamma_{4.51\ MeV \to 0\ MeV}$ is 4×10^{-5} times the ratio calculated using the Weisskopf model. (auth)

26948 ELECTROMAGNETIC DE-EXCITATION OF THE 11.89- AND 12.28-MeV LEVELS OF ^{22}Ne. Graff, J.; Chouraqui, G.; Port, M.; Thirion, J. M.; Jang, S.; Muller, Th. (Institut de Recherches Nucleaires, Strasbourg). J. Phys. (Paris), 29: 141-3 (Feb.-Mar. 1968). (In French).

By means of the ^{18}O(α,γ)^{22}Ne radiative capture, the $J^\pi = 1^-$ value was unambiguously determined for the 11.89- and 12.28-MeV excited states in ^{22}Ne, for which the previously reported results were contradictory. The characteristics of their transitions to the ground and first excited states were also measured. (auth)

26949 EXPERIMENTS WITH 3-MeV TRITONS. Chiba, Ren (Tokyo Inst. of Tech.). Nucl. Sci. Appl., 3: 36-9(Oct. 1967).

Using a triton beam accelerated by an electrostatic accelerator, the radioactive isotope ^{25}Mg was produced, and the activation cross section of the reaction ^{26}Mg(t,p)^{28}Mg was measured. Excitation functions and angular distributions of triton-induced reactions on ^{24}Mg, ^{26}Mg, and ^{12}C were investigated. The triton beam was used for activation analysis of oxygen by the ^{16}O(t,n)^{18}F reaction. (auth)

26950 STATISTICAL ANALYSIS OF ANGULAR DISTRIBUTIONS OF THE ^{35}Cl(p,α)^{32}S AND ^{37}Cl(p,α)^{34}S REACTIONS. Karadjev, K. V.; Manko, V. I.; Chukreyev, F. E. (Kurchatov Atomic Energy Inst., Moscow). Nucl. Sci. Appl., 3: 40-3(Oct. 1967).

Statistical analysis of the angular distributions of ^{35}Cl(P,α)^{32}S (^{36}Ar compound nucleus) and ^{37}Cl(P,α)^{34}S (^{38}Ar compound nucleus) reactions is performed. It is found that the systematics of the angular distributions are quite different in these two cases. For the ^{38}Ar nucleus, the systematics suggest a strong correlation of partial proton widths of different entrance channels. The histogram of the distribution of β_2 values has maxima at the points close to that corresponding to L-S-coupling case. For ^{36}Ar, the partial proton widths appear to be statistically independent. (auth)

26951 ^{27}Al(p,pπ^+)^{27}Mg REACTION FROM 0.6 TO 28 GeV. Poskanzer, A. M. (Univ. of California, Berkeley. Brookhaven National Lab., Upton, N. Y.); Cumming, J. B.; Remsberg, L. P. Phys. Rev., 168: 1331-5(Apr. 20, 1968). (UCRL-17759).

Measurements were made of the excitation function and integral recoil properties of the ^{27}Al(p,pπ^+)^{27}Mg reaction at incident proton energies from 0.6 to 28 GeV. The integral recoil properties yield values of the average forward momentum transfer. Calculations based on the model of Ericson et al. as modified by Selleri are in good agreement with the excitation function but predict somewhat smaller values for the average forward momentum transfer. (auth)

26952 LEVEL STRUCTURE OF LOW-LYING EXCITED STATES OF ^{46}Sc. Bolotin, H. H. (Argonne National Lab., Ill.). Phys. Rev., 168: 1317-30(Apr. 20, 1968).

The low-lying excited states of ^{46}Sc populated by primary and secondary γ-ray transitions from the ^{45}Sc(n,γ)^{46}Sc thermal-neutron-capture reaction were studied. Ge(Li) detectors were used exclusively in both singles and coincidence γ-ray investigations. High-energy primary γ-ray spectra were obtained and were used to infer the excitation energies of 53 states up to ~2600 keV. The neutron binding energy was determined to be 8767 ± 1 keV. Coincidence investigations between high-energy (~7–9 MeV) and low-energy (≲2 MeV) γ rays, as well as among the low-energy transitions, have allowed a total of 23 low-energy transitions to be assigned between states up to an excitation energy of 1324 keV. A level and decay scheme is proposed for a total of 57 excited states below an energy of 2600 keV. This scheme differs in several important respects from those proposed previously. The observed characteristics of these states are compared with the most recent charged-particle reaction studies, previous bent-crystal-spectrometer γ-ray results, and available theoretical calculations. (auth)

26953 DECAY OF 15-MIN ^{64}Ga TO ^{64}Zn. Li-Scholz, Angela; Bakhru, H. (Yale Univ., New Haven). Phys. Rev., 168: 1193-9(Apr. 20, 1968). (YALE-2726).

Fifteen-min ^{64}Ga was produced from the ^{63}Cu(α,2n)^{64}Ga reaction. The decay of this isotope was studied using Ge(Li) and Si(Li) detectors and scintillation counters. γ rays of the following energies were identified: 54, 61, 115, 153, 207, 654, 752, 769, 910, 932, 1047, 1227, 1342, 1353, and 1414 keV. Conversion electrons were observed for the 54-, 61-, 115-, and 153-keV transitions, from which multipolarity assignments were made. The half-life of the 115-keV state was measured by delayed coincidence and was found to be $4.6 \pm 0.7 \times 10^{-10}$ sec. Information from singles and coincidence measurements was incorporated into a decay scheme. The levels in ^{64}Zn found to be populated from the ^{64}Ga decay are at 54, 115, 207, 769, 867, 1047, 1342, and 1468 keV. (auth)

26954 TRANSITION PROBABILITIES FOR LOW-LYING STATES IN ^{46}Sc. Fossan, D. B. (State Univ. of New York, Stony Brook. Brookhaven National Lab., Upton, N. Y.); Chasman, C.; Jones, K. W. Phys. Rev., 168: 1200-4(Apr. 20, 1968). (BNL-11896).

Lifetimes of the low-lying levels of ^{46}Sc were studied using the ^{45}Sc(d,pγ)^{46}Sc reaction. The half-life of the 52-keV level was measured to be $t_{\frac{1}{2}} = 8.8 \pm 0.4$ μsec, which implies a B(E2) = 3.1×10^{-51} e^2cm^4 for an E2 transition to the ground state. A comparison of this result with shell-model calculations implies effective charges for the unpaired nucleons of $(e_p + e_n) = 5.43e$. Half-life limits from <200 to <400 psec have been placed on seven other low-lying transitions. No unusually large M1 hindrances were observed. (auth)

26955 NUCLEAR-STRUCTURE STUDIES OF THE LOW-LYING LEVELS OF ^{39}Ca. Lewis, M. B. (Duke Univ., Durham, N. C.); Roberson, N. R.; Tilley, D. R. Phys. Rev., 168: 1205-14(Apr. 20, 1968).

The low-lying levels of ^{39}Ca were studied by means of the ^{40}Ca(^{3}He,$\alpha\gamma$)^{39}Ca reaction. Angular-correlation measurements were carried out in a collinear geometry for the ground-state decays of the first three excited states of ^{39}Ca. The results of

these correlation studies, in conjunction with the results of previous reaction mechanism studies involving the first three ^{39}Ca levels, indicate J = $\frac{1}{2}^+$, $\frac{3}{2}^-$, and $\frac{5}{2}^-$ for the 2.47-, 2.80-, and 3.03-MeV levels, respectively. E3 and E1 multipolarities appear to dominate the 2.80- and 3.03-MeV transitions, respectively. γ-ray decay schemes from the first eight ^{39}Ca levels were also studied. Assuming at least partial dipole character for the γ rays of energy less than 2 MeV, a $\frac{1}{2}$ or $\frac{3}{2}$ assignment was made for the 3.66- and 3.88-MeV levels, and a $\frac{1}{2}$ or $\frac{5}{2}$ assignment was made for the 4.02-MeV level. The predominant ground-state transition for the 3.84-MeV level is consistent with a $\frac{3}{2}^-$ assignment for the level, and with E1 character for the transition. A comparison with the measurements which have been made on the mirror nucleus ^{39}K is made. A hole + ^{40}Ca core-excitation picture for the ^{39}Ca–^{39}K pair is viewed as a simplified model for the low-lying levels, and the parameters for the model were found to be similar to those previously used for the ^{27}Si–^{27}Al pair. (auth)

26956 REACTION CROSS SECTION FOR LOW-ENERGY ALPHA PARTICLES ON ^{59}Co. D'Auria, J. M.; Fluss, M. J.; Kowalski, L.; Miller, J. M. (Columbia Univ., New York). Contract AT(30-1)-1019. Phys. Rev., 168: 1224-7(Apr. 20, 1968). (CU-1019-62).

The reaction cross sections for α particles in the energy range 12.5 to 18.7 MeV with ^{59}Co were determined by summing measurements of the cross sections for the (α,n) reaction and those for charged-particle emission. These results are then combined with other reported investigations to obtain the reaction cross sections for incident α-particle energies 8 to 25 MeV. Comparison of these results with those from an optical-model calculation gives excellent agreement. (auth)

26957 MAGNETIC MOMENT AND CORE EXCITATION OF THE $d_{\frac{5}{2}}$ HOLE STATE IN ^{47}Sc. Fossan, D. B. (State Univ. of New York, Stony Brook. Brookhaven National Lab., Upton, N. Y.); Poletti, A. R. Phys. Rev., 168: 1228-32(Apr. 20, 1968).

The magnetic moment of the 760-keV level in ^{47}Sc was measured, using the reaction ^{44}Ca(α,p)^{47}Sc and the differential time-delay technique, to be μ = 0.35 ± 0.05 nm. The half-life for this level was measured as $t_{\frac{1}{2}}$ = 274 ± 10 nsec. This magnetic-moment result is consistent with an interpretation for this level of no core-excitation admixtures in the $d_{\frac{5}{2}}$ hole wave function. (auth)

26958 NUCLEAR STRUCTURE OF ^{22}Na, IV. GAMMA-RAY CORRELATION MEASUREMENTS. Warburton, E. K.; Poletti, A. R.; Olness, J. W. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 168: 1232-43(Apr. 20, 1968). (BNL-11954).

Gamma-gamma angular correlations were measured relative to the α beam in the ^{19}F(α,nγγ)^{22}Na reaction using NaI(Tl) γ-ray detectors. An ancillary determination of γ branching ratios for ^{22}Na states of interest was made through γ-γ coincidence measurements utilizing Ge(Li) and NaI(Tl) detector combinations. From these measurements and previous information, it was determined that the ^{22}Na 1.95-,2.97-, and 3.06-MeV levels have J = 2, 3, and 2, respectively. The quadrupole-dipole amplitude ratios of the 1.95 → 0.58, 2.97 → 1.95, and 3.06 → 1.95 transitions were determined to be +(0.04 ± 0.06), +(0.017 ± 0.034), and −(0.05 ± 0.15), respectively; i.e., the results are consistent in each case with pure dipole radiation. From measurements of the angular correlation of the ^{22}Na 1.528 → 0.891 → 0 γ-ray cascade, it was determined that the two members of this $5^+ \rightarrow 4^+ \rightarrow 3^+$ cascade have E2/M1 amplitude ratios of −(2.00 ± 0.15) and −(3.08 ± 0.32), respectively. From these mixing ratios and previously determined branching ratios and lifetimes for the ^{22}Na 1.528- and 0.891-MeV levels for E2 strengths of the 1.528 → 0.891 and 0.891 → 0 transitions are 20.7 ± 7.0 and 29.5 ± 4.5 Weisskopf units, respectively. These and other properties of ^{22}Na are in accord with a rotational-model interpretation of this nucleus. (auth)

26959 STUDIES IN THE DECAY OF 4.7-h ^{81}Rb. Li-Scholz, Angela; Bakhru, H. (Yale Univ., New Haven). Phys. Rev., 168: 1244-8(Apr. 20, 1968). (YALE-2726-H-96).

^{81}Rb (4.7-h) was produced from the ^{79}Br(α,2n)^{81}Rb and from the ^{79}Br(^{3}He,n)^{81}Rb reactions. The decay of this isotope was studied using Ge(Li) and standard NaI(Tl) counters. γ rays of the following energies were identified: 190.4, 357.6, 388.2, 446.0, 456.7, 476.6, 537.7. 547.7, 568.8, 729.7, 803.6, 835.4, and 978.0 keV. Information from singles and coincidence measurements was incorporated into a decay scheme. The proposed levels in ^{81}Kr are at 190, 457, 636, 994, and 1025 keV. (auth)

26960 M2 ISOMERISM IN ^{83}Rb AND HIGH-RESOLUTION SPECTROSCOPIC INVESTIGATIONS OF THE DECAY OF ^{83}Sr. Etherton, R. C. (Michigan State Univ., East Lansing. Southern Illinois Univ., Carbondale); Beyer, L. M.; Kelly, W. H.; Horen, D. J. Phys. Rev., 168: 1249-65(Apr. 20, 1968).

The photon spectrum accompanying the electron-capture decay of ^{83}Sr was studied with high-resolution Ge(Li) spectrometers in singles and coincidence configurations. The positron and internal-conversion-electron spectra were investigated with the MSU "orange" and $\pi\sqrt{2}$ iron-free electron spectrometers. Sixty transitions were identified. Excited states were placed in ^{83}Rb at 5.0, 42.3, 295.2, 389.2, 423.5, 736.8, 804.8, 994.2, 1043.7, 1053.7, 1103.0, 1202.0, 1242.6, 1273.1, 1324.6, 1653.1, 1756.9, 1783.5, 1916.7, 1952.2, 2014.8, 2090.0, 2147.8, and 2179.3 keV. Internal-conversion coefficients, log ft, and γ-ray branching ratios were used to place limits upon the spins and parities of the excited states. An isomeric M2 transition of 42.3 keV was identified. The ground-state spin and parity of ^{83}Sr were shown to be $\frac{1}{2}^+$, which are the same as for all other known 45-neutron nuclei. (auth)

26961 DOPPLER-SHIFT LIFETIME MEASUREMENTS IN ^{24}Mg, ^{26}Mg, AND ^{28}Si. Robinson, S. W.; Bent, R. D. (Indiana Univ., Bloomington). Phys. Rev., 168: 1266-86(Apr. 20, 1968).

The lifetimes of nuclear levels in ^{24}Mg, ^{26}Mg, and ^{28}Si were measured by the Doppler-shift attenuation method. Excited states were produced by inelastic scattering of 22-MeV α particles from the Indiana University cyclotron. γ-ray spectra taken in coincidence with α-particles striking an annular detector in the backward direction. The Doppler shifts of the γ-ray peaks were attenuated by thick gold backings behind the targets, allowing the lifetimes of the levels to be calculated in terms of the attenuation and the stopping power of the gold backing. Lifetimes were measured for the 1.37-, 4.12-, and 4.23-MeV levels of ^{24}Mg; the 1.81- and 2.94-MeV levels of ^{26}Mg; and the 1.77-, 4.61-, and 4.97-MeV levels of ^{28}Si. In addition, studies were made of the decay rates of the 5.25-, 6.01-, and 6.43-MeV levels of ^{24}Mg; the triplet at 4.32–4.35 MeV in ^{26}Mg; and the 6.889-MeV level in ^{28}Si. The results for these three even-even s-d shell nuclei are compared with the predictions of several collective theories of nuclear structure, with shell-model calculations based on the SU_3 classification of states, and with Hartree–Fock calculations. (auth)

26962 ^{3}He SCATTERING FROM NICKEL AND ZIRCONIUM ISOTOPES. Rundquist, D. E.; Brussel, M. K.; Yavin, A. I. (Univ. of Illinois, Urbana). Phys. Rev., 168: 1287-95(Apr. 20, 1968).

Angular distributions for elastic and inelastic ^{3}He scattering from ^{58}Ni, ^{60}Ni, ^{61}Ni, ^{64}Ni, ^{90}Zr, ^{91}Zr, ^{92}Zr, and ^{94}Zr targets were compiled at an incident beam energy of 25 MeV. Optical-model fits were obtained to the ^{3}He elastic scattering angular distributions. Collective-model distorted-wave calculations were made for the inelastic scattering, utilizing the parameters obtained from the optical-model analysis of the elastic scattering, and deformation parameters were extracted. The inelastic transitions in ^{61}Ni are interpreted by the core-excitation model. (auth)

26963 PHOTONEUTRON PRODUCTION CROSS SECTIONS OF NICKEL AND SILVER. Fielder, D. S.; Min, K.; Whitehead, W. D. (Univ. of Virginia, Charlottesville). Phys. Rev., 168: 1312-16(Apr. 20, 1968).

The least-structure solutions for the photoneutron production cross sections of natural nickel and silver were obtained from the neutron thresholds up to 25 MeV. The experimental results are compared with the theoretical dipole-strength distributions given by the dynamic collective theory and the theory of collective correlations. (auth)

26964 THE ^{42}Ca(d,n)^{43}Sc REACTION AT E_d = 5.15 MeV. Grandy, T. B.; McDonald, W. J.; Dawson, W. K.; Neilson, G. C. (Univ. of Alberta, Edmonton). Nucl. Phys., A111: 469-80(1968).

A large number of states in ^{43}Sc were studied with the ^{42}Ca(d,n)^{43}Sc reaction at 5.15 MeV. Angular distributions of neutrons were measured for a number of the stronger transitions and compared with DWBA predictions. Excitation energies, l-values and relative spectroscopic factors are shown to be in good agreement with previously measured values. A $\frac{1}{2}^+$ assignment was given to a level at 1.947 MeV. In addition, an assignment of l = 1 was made for the transition to a level at 6.155 MeV (possible isobaric analog of the 2.048 MeV state in ^{43}Ca) on the basis of the Butler plane-wave theory. (auth)

26965 SOME LOW-LYING ENERGY LEVELS OF ^{45}Ti. Jones, G. D.; Johnson, R. R.; Jett, J. H. (Univ. of Colorado, Boulder). Contract AT(11-1)-535. Nucl. Phys., A111: 449-56(1968). (COO-535-580).

Angular distributions were obtained for the ^{46}Ti(p,d)^{45}Ti reaction at a proton bombarding energy of 26 MeV. Several new energy levels were observed in ^{45}Ti up to an excitation energy of 6.33 MeV. Orbital angular momentum assignments were made to most of the levels on the basis of DWBA calculations. Spectroscopic factors were extracted assuming j-values suggested by the shell model. (auth)

26966 ISOBARIC ANALOGUE STATES IN ^{32}S POPULATED BY THE ^{32}P(d,n)^{32}S REACTION. Ferguson, A. T. G. (Atomic

Energy Research Establishment, Harwell, Eng.); Nilsson, L.; Starfelt, N. Nucl. Phys., A111: 423-32(1968).

The $^{31}P(d,n)^{32}S$ reaction was studied at a deuteron energy of 4.9 MeV. Neutron energies were measured by the use of time-of-flight techniques. Analysis of angular distributions yielded l_p values for eight levels in ^{32}S. Three T = 0 and two T = 1 states formed by s-wave proton transfer were identified. The experimental isobaric spin energy splitting is found to be 7.5 MeV which is considerably larger than for other doubly even nuclei in this mass region. This difference is explained at least partly by the fact that in this case different configurations predominate in the T = 0 and the T = 1 states. (auth)

26967 NEUTRON-INDUCED REACTIONS ON SILICON: DEUTERON AND ALPHA PARTICLE ANGULAR DISTRIBUTION AT E_n = 21.3 MeV. Bohne, W.; Hilscher, D.; Homeyer, H.; Morgenstern, H.; Scheer, J. A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A111: 417-22(1968).

At a neutron energy of 21.3 MeV, the angular distributions of deuterons and alpha particles emitted in the reactions $^{28}Si(n,d)$ and $^{28}Si(n_0,\alpha)$ were measured. DWBA fits were made, and spectroscopic factors extracted. The yield was also measured in the range E_n = 14 to 22 MeV. (auth)

26968 PROJECTED HARTREE–FOCK STATES FOR ^{20}Ne AND ^{28}Si USING A REALISTIC TWO-BODY POTENTIAL. Stamp, A. P.; Spencer, M. B. (Univ. of Auckland, New Zealand). Nucl. Phys., A111: 353-9(1968).

The rotational energy spectrum is calculated by projecting the states from the axially symmetric Hartree-Fock wave functions. The spectrum is found to be compressed indicating that the Hartree-Fock wave functions are not good, even though the binding energy is accounted for. As a further test the energy variance is evaluated. (auth)

26969 DECAY OF ^{65}Zn. Stelson, P. H. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A111: 331-4(1968). (ORNL-P-3637).

The principal decay of ^{65}Zn is to the second excited state ($\frac{5}{2}^-$) of ^{65}Cu at 1115 keV, which in turn decays directly to the ground state by the emission of a 1115 keV γ-ray. The measurement of a small amount of cascade decay to the first excited state at 771 keV ($\frac{1}{2}^-$) is reported. The branching ratio (cascades/crossovers) is $(6.0 \pm 0.6) \times 10^{-5}$. From the known total mean life for the 1115 keV state and the branching ratio, the B(E2) for the 344 keV pure E2 transition is found to be $(2.67 \pm 0.30) \times 10^{-51}$ cm^4 (enhancement 1.7 ± 0.2). Thankappan and True have predicted a value of 1.19×10^{-51} cm^4 for the B(E2) of the analogous transition in ^{63}Cu. (auth)

26970 PROTON TOTAL REACTION CROSS SECTIONS AT 9.1 MeV. Bulman, P. J.; Griffith, J. A. R. (Univ. of Birmingham, Eng.). Nucl. Phys., A111: 315-20(1968).

Proton total reaction cross sections were measured at 9.1 MeV for Mg, Ti, ^{63}Cu, ^{65}Cu, natural Cu, and Zr using a counter anti-coincidence technique. These and earlier results were compared with the predictions of the nuclear optical model. Good agreement was found in the case of medium-weight nuclei. (auth)

26971 ELASTIC SCATTERING OF 52 MeV DEUTERONS. Hinterberger, F. (Univ., Bonn); Mairle, G.; Schmidt-Rohr, U.; Wagner, G. J. Nucl. Phys., A111: 265-88(1968).

Angular distributions for the elastic scattering of 52 MeV deuterons were measured from 27 nuclei ranging from hydrogen to uranium. The experimental data were analyzed in terms of the optical model. The inclusion of a vector spin–orbit term in the potential is necessary for nuclei with A > 100. For light nuclei with $12 \leq A \leq 50$, good fits to the experimental angular distributions could also be obtained without a spin-orbit potential. The optical-model parameters for nuclei with $A \geq 12$ are discussed with respect to the dependence on the energy E, the charge Z and the mass A. The A-dependence of the real potential depth V can be understood as a consequence of the spatial polarization of the deuteron during the scattering process. Discrepancies between optical-model calculations and experimental angular distributions observed in the elastic scattering processes from ^1H, ^3He, and ^4He indicate contributions from transfer reactions. (auth)

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26978 EXCITED STATES OF ^{23}Ne BY $^{22}Ne(d,p)^{23}Ne$. Lambert, M.; Dumazet, G.; Beaumevieille, H.; Midy, P.; Tellez, A. (Institut d'Etudes Nucleaires, Algiers). pp 112 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27004 NUCLEAR RESONANCE FLUORESCENCE WITH A STRONG ^{60}Co RADIOACTIVE SOURCE. Mouton, W. L.; Celliers, P. J.; Koen, J. W.; Rust, N. J. (Univ. of Stellenbosch, S. Africa). pp 199 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27011 INELASTIC SPIN-FLIP-SCATTERING ($\Delta m = \pm 1$) OF 11.8-MeV DEUTERONS ON ^{24}Mg, ^{26}Mg, ^{32}S, ^{58}Ni, AND ^{60}Ni. Pfleger, J. A. H.; Vieth, H. M.; Jahr, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 285 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27013 (d,pγ) CORRELATIONS IN THE REACTIONS ^{28}Mg(d,p)^{27}Mg AND ^{28}Si(d,p)^{29}Si. Adams, A.; Calvert, J. M. (Univ. of Manchester, Eng.). pp 287 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27017 THE ^{27}Al(^{3}He,^{3}He)^{27}Al AND ^{27}Al(^{3}He,α)^{26}Al REACTIONS. Odera, M.; Kohno, I.; Takeda, S.; Nakajima, S. (Inst. of Physical and Chemical Research, Saitama, Japan). pp 292 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27020 ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES FROM ^{40}Ar. Wakatsuki, T. (Osaka Univ.); Takahashi, N. Suzuki, K.; Itahashi, T.; Hirao, Y. pp 295 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27021 (^{3}He,α) REACTIONS ON LIGHT NUCLEI. Vergnes, M.; Rotbard, G.; Ronsin, G.; Kalifa, J. (Institut de Physique Nucleaire, Orsay, France). pp 296 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27024 THE SPIN–SPIN INTERACTION OF 1.19-MeV POLARIZED ^{60}Co NUCLEI. Kobayashi, S.; Nagamine, K.; Imaizumi, M.; Uchida, A.; Katori, K. (Tokyo Univ.). pp 301 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27026 ELASTIC AND INELASTIC SCATTERING OF ^{3}He FROM Ni ISOTOPES. Kamitsubo, H.; Fujisawa, T.; Wada, T. (Inst. of Physical and Chemical Research, Saitama, Japan). pp 303 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27027 DIFFERENTIAL CROSS SECTIONS (p,p), (p,p′) OF ^{64}Zn, ^{66}Zn, ^{68}Zn, AND ^{70}Zn FOR 49.08-MeV PROTONS. Calderbank, M. (King's Coll., London); Burge, E. J.; Lewis, V. E.; Smith, D. A.; Ganguly, N. K. pp 304 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27028 SPINS AND DECAY SCHEMES OF ^{30}Si(p,γ)^{31}P RESONANCE LEVELS AT E_p = 2 TO 3 MeV. Bornman, C. H.; Meyer, M. A.; Wolmarans, N. S.; Reitmann, D. (Atomic Energy Board, Pelindaba, S. Africa). Nucl. Phys., A112: 231-40(1968).

Proton capture resonances in ^{30}Si(p,γ)^{31}P were studied in the energy range E_p = 2 to 3 MeV. The gamma-ray decay of 26 resonances were investigated with a 10 cm^3 Ge(Li) detector. Unique spins for 22 of these resonance levels were found from double and triple angular correlation measurements with NaI(Tl) detectors. The resonance at E_p = 2698 keV was shown to be a doublet with spins $^5/_2$ and $^3/_2$. A new bound state is proposed at E_x = 6507 ± 2 keV. The quadrupole/dipole mixing ratios for the 1.27 → 0 and 4.19 → 1.27 MeV transitions, were found to be 0.31 ± 0.01 and 0.10 ± 0.03, respectively. (auth)

27029 POLARIZATION IN THE ELASTIC SCATTERING OF 12-MeV DEUTERONS BY ^{12}C, ^{56}Fe, AND ^{58}Ni. Baxter, A. M.; Griffith, J. A. R.; Oh, S. W.; Roman, S. (Univ. of Birmingham, Eng.). Nucl. Phys., A112: 209-22(1968).

Angular distributions are presented of the vector polarization of 12-MeV deuterons elastically scattered by ^{12}C, ^{56}Fe, and ^{58}Ni for lab scattering angles 20 to 160°. The vector polarized deuteron beam from the Birmingham Radial Ridge Cyclotron polarized deuteron source was used, and the experimental method involved frequent "on-off" switching of the polarization at the source. Asymmetries were measured, using semiconductor detector telescopes in the scattering plane, against simultaneous readings of a carbon polarimeter whose analysing power was calibrated by means of the d-^{4}He scattering. Large values of polarization were observed for ^{12}C; the medium-weight nuclei ^{56}Fe and ^{58}Ni showed characteristic oscillatory patterns of lower amplitude. An attempt was made to explain the results in terms of optical-model predictions, and the calculations seem to favour a potential for deuterons approximating the sum of the proton and neutron optical model potentials. (auth)

27030 THE REACTION ^{37}Cl(^{3}He,α)^{36}Cl AND THE ^{36}S GROUND-STATE ANALOG. Broman, Lars; Fou, C. M.; Rosner, Baruch (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., A112: 195-203(1968).

The reaction ^{37}Cl(^{3}He,α)^{36}Cl was studied using a 15-MeV ^{3}He beam. Some 34 states up to 12.2-MeV excitation energy were observed. Angular distributions were measured for 11 states and were compared with DWBA predictions in order to yield spectroscopic information. The ^{36}S ground-state analog was identified at 4.33-MeV excitation energy, from which the Coulomb displace-

ment energy for the pair $^{36}Cl-^{36}S$ was calculated to be 6.25 MeV. (auth)

27031 $^{20}Ne(d,p)^{21}Ne$ AND EXCITED STATES OF ^{21}Ne. Lambert, M. (Institut d'Etudes Nucleaires, Algiers); Dumazet, G.; Beaumevieille, H.; Tellez, A.; Meynadier, C.; Midy, P.; Nguyen Van Sen. Nucl. Phys., A112: 161-84(1968).

Using a gas target with differential pumping, absolute differential cross sections for 14 proton groups from the reaction $^{20}Ne(d,p)^{21}Ne$ were measured at 2, 3, and 3.2 MeV. A DWBA analysis of the transitions proceeding by a stripping mechanism allows the determination of orbital angular momenta and spectroscopic factors. The results are discussed in terms of the Nilsson model. (auth)

27032 A HIGH-RESOLUTION GAMMA-RAY SPECTROSCOPIC STUDY OF THE DECAY $^{77}Ge \rightarrow {}^{77}As$. Donnelly, D. P.; Reidy, J. J.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A112: 145-55(1968).

The energy and relative intensity values of 82 gamma rays following the decay of ^{77}Ge were measured. The energy values of seven of these lines were measured using a 2-m curved-crystal spectrometer; the other measurements were made using Ge(Li) spectrometers. A level scheme was constructed which included 28 excited levels and places 74 transitions. The energies of the levels (in keV) are 215.5, 264.5, 459.6, 461.4, 475.5, 613.6, 632.1, 784.8, 875.3, 914.2, 1189.7, 1202.7, 1280.8, 1319.6, 1382.5, 1398.4, 1457.7, 1479.9, 1539.6, 1560.6, 1717.4, 1719.7, 2000.2, 2109.0, 2143.7, 2303.5, 2341.7, and 2513.2. (auth)

27033 THE DECAY OF ^{56}Co AND ^{56}Mn. Sher, A. H.; Pate, B. D. (Simon Fraser Univ., Burnaby, Can.). Nucl. Phys., A112: 85-96(1968).

Gamma radiations following the radioactive decay of ^{56}Co and ^{56}Mn were measured with Ge(Li) detectors. From ^{56}Co, previously unobserved gamma rays of energies 2213.0 and 3598.7 keV were identified while those of energies 1810.9, 1963.4, and 2112.8 keV are confirmed. Gamma–gamma coincidence measurements were carried out with Ge(Li) and NaI(Tl) detectors. Gamma spectra in coincidence with the 846.6-, 1037.6-, and 1238.0-keV gamma rays were measured, and a number of gamma–gamma cascades identified. From ^{56}Mn, a previously unreported gamma ray of energy 3119.3 keV was observed. A revised decay scheme is presented together with a discussion of the information that the new data provide on level energies, spins, and parities. (auth)

27034 TRIPLE CORRELATIONS IN THE REACTIONS $^{58}Ni(p,\gamma\gamma)^{59}Cu$ AND $^{62}Ni(p,\gamma\gamma)^{63}Cu$. Treado, P. A.; Gossett, C. R.; August, L. S. (Naval Research Lab., Washington, D. C.). Nucl. Phys., A112: 32-46(1968).

Approximately 50 resonances having a yield of greater than 100 gamma rays per μC were discernible from the $^{62}Ni(p,\gamma)^{63}Cu$ reaction in the range of proton energy from 1100 keV to 1850 keV. Gamma-ray energy measurements obtained by utilizing scintillation and lithium-drifted silicon spectrometers yield 3.42 ± 0.02 MeV and 6.14 ± 0.02 MeV for the Q-value of the $^{58}Ni(p,\gamma)^{59}Cu$ and $^{62}Ni(p,\gamma)^{63}Cu$ reactions, respectively. The existence of intermediate states was observed in ^{59}Cu at 0.49 ± 0.01, 0.91 ± 0.01, 1.38 ± 0.02, 2.00 ± 0.02 and 2.32 ± 0.02 MeV; and in ^{63}Cu at 0.67 ± 0.01 and 1.55 ± 0.02 MeV. Triple-correlation measurements were performed with a double sum-coincidence spectrometer at resonance energies of 1424, 1663 and 1715 keV for the $^{58}Ni(p,\gamma\gamma)^{59}Cu$ reaction and at resonance energies of 1374, 1414, 1507 and 1634 keV for the $^{62}Ni(p,\gamma\gamma)^{63}Cu$ reaction. These measurements permitted J^π assignments of $(^1/_2)$, $^5/_2^-$, $^3/_2^-$, $^5/_2^-$ and $(^3/_2^-)$ or $(^5/_2^-)$ to the intermediate states in ^{59}Cu at 0.49, 0.91, 1.38, 2.00 and 2.32 MeV, respectively; and $(^1/_2)$ and either $(^3/_2^-)$, $(^5/_2^-)$, or $(^3/_2^+)$ to the intermediate states in ^{63}Cu at 0.67 and 1.55 MeV, respectively. The E2/M1 amplitude ratios were obtained whenever possible from the correlation data. (auth)

27035 ANGULAR CORRELATION STUDIES IN ^{50}Cr. Mo, J. N.; Lewis, C. W.; Thomas, M. F.; Twin, P. J. (Univ. of Liverpool). Nucl. Phys., A111: 657-77(1968).

Proton-gamma angular correlation measurements were used to determine spins and establish modes of decay for some of the low lying levels in ^{50}Cr. The spins of the 3.317, 3.621, and 3.786 MeV states are found to be 4, 1, and 5, respectively. Confirmation of previous spin assignments to the 2.922, 3.156, and 3.692 MeV states are reported together with multipole mixing ratios of relevant gamma rays from all six states. Branching ratios were measured for the above states and those at 3.838, 3.888, 3.927, and 4.123 MeV. The results are discussed in relation to ^{46}Ti, a cross-conjugate nucleus in an $(f_{\frac{7}{2}})^n$ description, and the theoretical predictions of McCullen, Bayman, and Zamick. (auth)

27036 EFFECT OF THE ISOSPIN SELECTION RULE ON DIPOLE TRANSITIONS IN ^{24}Mg AND ^{28}Si. Lawergren, B. T. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., A111: 652-6(1968).

Absolute γ-ray transition rates were estimated for levels found as resonances in (p,γ) reactions on ^{23}Na and ^{27}Al and 37 (in ^{24}Mg) and 54 (in ^{28}Si) cases of dipole radiation were identified between levels with known J, π and T quantum numbers. Forbidden E1 transitions between levels with $\Delta T = 0$ are indeed retarded with respect to the allowed $\Delta T = 1$ transitions. However, the existence of these forbidden transitions indicates a small amount of isospin admixture in the high-lying T = 0 levels. The average rate of forbidden E1 transitions is similar to that in lighter nuclei, while the average rate of allowed is ≈ 15 times slower here than in lighter nuclei. It is suggested that this is a consequence of the increased level density in the heavier nuclei and the presence of isospin mixtures among the radiating levels. (auth)

27037 ANGULAR DISTRIBUTION OF GAMMA RAYS FROM INELASTIC NEUTRON SCATTERING NEAR THRESHOLD. Torop, Lee (Stanford Univ., Calif.). Nucl. Phys., A111: 513-28 (1968).

The angular distributions of gamma rays following inelastic neutron scattering near threshold to the first excited states of the target nuclei were investigated experimentally and theoretically. Measurements used NaI(Tl) crystal detectors and natural targets of Fe and Ce. Data were obtained for the angular distribution of gamma rays following inelastic neutron scattering by ^{56}Fe at the neutron center-of-mass energies E = 0.87, 0.90, 0.93, 0.95, and 0.99 MeV and by ^{140}Ce at E = 1.64, 1.67, 1.71, 1.75, and 1.87 MeV. The predictions for the gamma-ray angular distributions of the two following theories are determined: the Snatchler-Sheldon theory, and the theory of Moldauer, specialized to the pure compound nucleus process and employing the "uncorrelated amplitude" assumption. Near threshold the predictions of the two theories are nearly the same. Theory and experiment are in good agreement with cerium at all energies at which angular distributions were obtained and for iron at E = 0.99 MeV but not at lower energies. Two general conclusions are drawn about measurements of the angular distribution of gamma rays following inelastic neutron scattering in medium and heavy nuclei at energies near threshold; such measurements are not useful in deciding between the theories of Satchler-Sheldon and Moldauer, but they provide data for a sensitive test of the Hauser-Feshbach statistical assumptions. (auth)

27038 SPINS OF THE FIRST TWO EXCITED STATES IN ^{27}Mg BY AN ANGULAR CORRELATION TECHNIQUE IN THE REACTION $^{25}Mg(d,p\gamma)^{27}Mg$. Eswaran, M. A.; Ragoowansi, N. L. (Bhabha Atomic Research Centre, Bombay). Proc. Indian Acad. Sci., Sect. A, 67: 19-30(Jan. 1968).

Proton-gamma angular correlation measurements, employing the method II of Litherland and Ferguson (Can. J. Phys., 39: 788(1961)) were made in the reaction $^{25}Mg(d,p\gamma)^{27}Mg$, using a 1.80-MeV deuteron beam and detecting the outgoing protons at 0° with respect to the beam. Analysis of these measurements leads to spin assignments of $^3/_2$ and $^5/_2$ for the 0.98- and 1.69-MeV excited states of ^{27}Mg. The 1.69-MeV second excited state is found to decay almost completely to the ground state. (auth)

27039 MULTIPLE SCATTERING OF α PARTICLES. Lassen, N. O.; Ohrt, Arne. Kgl. Dan. Vidensk. Selsk., Mat.-Fys. Medd., 36: No. 9, 3-16(1967).

The distributions in the projected angle of α particles having passed thin foils of Be, Al, Ni, or Au, respectively, were measured. For 20-MeV α particles, both the shape of the distributions and the half-widths were found to agree with Molière's theory. Also for 8.8- and 6.0 MeV-α particles the half-widths agree with his theory. (auth)

27040 PIONIC 3d-2p TRANSITIONS. Poelz, G.; Schmitt, H.; Tauscher, L.; Backenstoss, G.; Charalambus, S.; Daniel, H.; Koch, H. (CERN, Geneva. Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Karlsruhe, Ger.). Phys. Lett., 26B: 331-3 (Feb. 5, 1968).

Pionic 3d–2p transitions from Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu and Zn were measured with Ge counters. Data for 2p-level shifts and widths are given. (auth)

27041 EFFECTIVE THREE-BODY INTERACTIONS IN Ca ISOTOPES. Osnes, E. (NORDITA, Copenhagen). Phys. Lett., 26B: 274-7(Feb. 5, 1968).

The contributions of effective three-body forces to the binding energies of the Ca isotopes are calculated with G-matrix elements of the Hamada–Johnston potential and are found to be small. (auth)

27042 THE ^{43}Ca GROUND-STATE ANALOGUE. Vingiani, G. B.; Chilosi, G.; Bruynesteyn, W. (Univ., Utrecht). Phys. Lett., 26B: 285-7(Feb. 5, 1968).

The reaction $^{48}Ca(p,p)^{48}Ca$ was investigated, with proton detection at seven angles, in the region E_p = 1940 to 2000 keV, corresponding to the position of the analogue of the ^{49}Ca ground state. The analogue is split into seven components of which the three strongest certainly, and the others most probably have $J^\pi = \frac{3}{2}^-$. Gamma rays from the reactions $^{48}Ca(p,\gamma)^{49}Sc$ and $^{48}Ca(p,n\gamma)^{48}Sc$ were detected with a Ge(Li) counter. Partial widths are deduced. (auth)

27043 METASTABLE STATE AT 1.64 MeV IN ^{40}K. Main, I. G.; Dawson, N.; Kewley, D.; Lawley, N.; Thomas, M. F.; Twin, P. J. (Liverpool Univ.). Phys. Lett., 26B: 295-7(Feb. 5, 1968).

The mean lifetime of the 1.64-MeV level in ^{40}K was measured to be 0.49 ± 0.01 μs, and its decay scheme was determined. From the results, it is argued that the most probable spin and parity for the level are $J^\pi = 0^+$. The experiment simultaneously yielded a value of 0.63 ± 0.02 μs for the mean lifetime of the first excited state of ^{72}Ge. (auth)

27044 RESTORATION OF AXIAL SYMMETRY OF THE EQUILIBRIUM SHAPE OF ^{24}Mg BY PAIRING CORRELATIONS. Goodman, A. L.; Struble, G. L.; Goswami, A. (Univ. of California, Berkelye). Contract W-7405-Eng-48. Phys. Lett., 26B: 260-3(Feb. 5, 1968). (UCRL-17900).

A generalized quasiparticle transformation is presented which included n-n, p-p, and n-p (T = 0 and T = 1) pairing correlations. The resulting gap equations for N = Z nuclei are solved for ^{24}Mg, indicating that n-p (T = 0) pairing correlations restore axial symmetry to the equilibrium shape. (auth)

27045 VALIDITY OF HARTREE–FOCK CALCULATIONS BEFORE ANGULAR MOMENTUM PROJECTION: A TEST IN ^{20}Ne. Satpathy, L.; Nair, S. C. K. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Lett., 26B: 257-9(Feb. 5, 1968).

A variational calculation after angular momentum projections for the first three states of ^{20}Ne is performed. A comparison of these results with those of a Hartree–Fock calculation before angular momentum projection provides a justification for the latter procedure. (auth)

27046 SHELL-MODEL CALCULATIONS OF ^{56}Cr AND ^{58}Fe. McGrory, J. B. (Oak Ridge National Lab., Tenn.). Phys. Lett., 26B: 604-6(Apr. 15, 1968). (ORNL-P-3726).

The results of shell-model calculations of the nuclei ^{56}Cr and ^{58}Fe are discussed. The predicted energy level spectra are in good agreement, except for the predicted first excited $J = 0^+$ state in ^{56}Cr, for which the experimental analogue is missing. (auth)

27047 CONSEQUENCES OF A TRIAXIAL INTRINSIC STATE FOR ^{24}Mg. Parikh, J. C. (Univ. of Rochester, N. Y.). Phys. Lett., 26B: 607-9(Apr. 15, 1968).

Stripping intrinsities predicted by various deformed Hartree–Fock solutions for ^{24}Mg are compared with those known experimentally. The axial solution is favored although the triaxial is lower in energy. A possible explanation could be the recent findings of Goodman et al. (auth)

27048 K-SHELL CONVERSION COEFFICIENT OF THE 102.7-keV TRANSITION IN THE ^{81m}Se DECAY. Rao, P. Venugopala; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Phys. Lett., 26B: 618-19(Apr. 15, 1968).

A precision value of $\alpha_K = 8.4 \pm 0.4$ for the 102.7-keV isomeric transition in 57-min ^{81m}Se decay was measured. Since the theoretical value for a pure E3 transition is only 5.4, and M4 admixture of 4.5 ± 0.6% is indicated. (auth)

27049 LIFETIMES OF 2^+ STATES IN ^{58}Ni. Bertin, M. C. (Rutgers–The State Univ., New Brunswick, N. J.); Benczer-Koller, N.; Seaman, G. G.; MacDonald, J. R. Phys. Lett., 26B: 623-5 (Apr. 15, 1968).

The mean lifetimes of six 2^+ states in ^{58}Ni were measured by the Doppler shift attenuation method, and 16 transition probabilities were extracted. The results were compared with some recent calculations of electromagnetic transition probabilities. (auth)

27050 $^{89}Y(d,p)^{90}Y$ REACTION AT ENERGY BELOW THE COULOMB BARRIER. Morita, S.; Tohei, T.; Yamaya, T.; Nakagome, Y.; Iwasaki, S.; Hiratate, Y.; Lee, S. M. (Tohoku Univ., Sendai). pp 305 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27051 ISOSPIN-FORBIDDEN RESONANCES IN p-SHELL AND sd-SHELL NUCLEI. Temmer, G. M.; Teitelman, B.; Van Bree, R.; Ogata, H. (Rutgers–The State Univ., New Brunswick, N. J.). pp 318 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27052 ISOBARIC ANALOGUE RESONANCES IN ^{52}Cr AND ^{54}Fe. Teranishi, E.; Furubayashi, B. (Electrotechnical Lab., Tokyo). pp 319 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27053 STUDIES OF THE $^{54}Fe(p,p)$ AND $^{54}Fe(p,p')$ REACTIONS. Awaya, T.; Ohmura, H.; Sekiguchi, M.; Yamashita, H.; Sakurai, K.; Soga, F.; Ishiga, T. (Tokyo Univ.). pp 320 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27054 ISOBARIC ANALOGUE STATES OF THE HIGHLY EXCITED STATES. Obu, M.; Terasawa, T. (Tokyo Univ.). pp 321 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27055 ISOMERIC RATIOS AND TOTAL CROSS SECTIONS FOR COMPOUND REACTIONS. Decowski, P.; Grochulski, W.; Marcinkowski, A.; Siwek, K.; Sledzinska, I.; Wilhelmi, Z. (Univ., Warsaw. Inst. of Nuclear Research, Warsaw). pp 333 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27056 THE $^{24}Mg(d,\alpha)^{22}Na$ REACTION AT LOW ENERGIES. Wang, W. N.; Lin, E. K.; Hsu, C. C.; Chiao, T. (National Tsing Hua Univ., Hsinchu, Taiwan. Academia Sinica Hsinchu, Taiwan). pp 342 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27057 INTERMEDIATE RESONANCES IN THE REACTION $^{24}Mg(d,p)^{25}Mg$. Lee, S. M.; Hiratate, Y.; Miura, K.; Kato, S.; Morita, S. (Tohoku Univ., Sendai). pp 343 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27058 STUDY OF THE $^{26}Mg(d,\alpha)^{24}Na$ REACTION AT LOW ENERGIES. Hsu, C. C.; Lin, E. K.; Wang, W. N.; Chiao, T. (National Tsing Hua Univ., Hsinchu, Taiwan. Academia Sinica, Hsinchu, Taiwan). pp 344 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27059 THE $^{26}Mg(d,p)^{27}Mg$ REACTION AT LOW ENERGIES. Lin, E. K.; Wang, W. N.; Hsu, C. C.; Chiao, T. (National Tsing Hua Univ., Hsinchu, Taiwan). Academia Sinica, Hsinchu, Taiwan). pp 345 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27060 STUDY OF STRUCTURE IN THE REACTIONS $^{27}Al(p,\alpha_0)^{24}Mg$ AND $^{27}Al(p,\alpha_1)^{24}Mg^*$ FROM 4.00 to 5.50 MeV. Mehta, M. K.; Divatia, A. S. (Bhabha Atomic Research Centre, Trombay, India). pp 346 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27061 EVIDENCE FOR SPREADING OF THE STRENGTH OF INTERMEDIATE STATES OF ^{30}Si. Kroepfl, J. J.; Marvin, T. P.; Watson, B. A.; Singh, P. P. (Indiana Univ., Bloomington). pp 347 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27062 RESONANCE IN THE ELASTIC SCATTERING OF ALPHA PARTICLES ON ^{39}K AT 24 MeV. Bobrowska, A.; Budzanowski, A.; Grotowski, K.; Jarczyk, L.; Micek, S.; Niewodniczanski, H.; Strzalkowski, A.; Wrobel, Z. (Inst. of Nuclear Physics, Krakow. Jagellonian Univ., Krakow). pp 348 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27063 THE $^{40}Ca(p,p)^{40}Ca$ REACTION. Rich, W. F.; Class, C. M. (Rice Univ., Houston, Tex.). pp 349 of Contributions,

International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27064 FLUCTUATION ANALYSIS OF THE $^{51}V(p,p)^{51}V$ REACTION. Lamba, C. M. (Bhabha Atomic Research Centre, Bombay); Sarma, N.; Thampi, N. S.; Sood, D. K.; Deshpande, V. K. pp 350 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27065 INTERMEDIATE RESONANCES IN THE ^{58}Ni +p REACTIONS. Izumo, Ko (Nihon Univ., Tokyo); Swenson, L. W. pp 351 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27066 TOTAL NEUTRON CROSS SECTION IN Mn AND Co. Garg, J. B. (State Univ. of New York, Albany); Rainwater, J.; Havens, W. W. Jr. pp 356 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27067 ELASTIC AND INELASTIC SCATTERING OF NEUTRONS. Tsukada, K.; Tanaka, S.; Maruyama, M.; Tomita, Y. (Japan Atomic Energy Research Inst., Tokyo). pp 357 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27068 KeV HIGH RESOLUTION NEUTRON RADIATIVE CAPTURE MEASUREMENTS. Block, R. C.; Bartolome, Z. M.; Hockenbury, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. pp 358 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27069 NEUTRON CROSS SECTIONS AND STRENGTH FUNCTIONS OF GERMANIUM ISOTOPES. Malecki, H.; Pikelner, L. B.; Salamatin, I. M.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 360 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27070 PRECOMPOUND AND COMPOUND PARTICLES OF DECAY IN (n,p) REACTIONS. Kondaiah, E.; Parthasaradhi, K. (Andhra Univ., Waltair, India). pp 364 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27071 ELECTRON SCATTERING FROM Mg AT 180°. Fagg, L. W.; Bendel, W. L.; Tobin, R. A.; Kaiser, H. F.; Jones, E. C. Jr. (Naval Research Lab., Washington, D. C.). pp 365 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27072 INVESTIGATION OF THE GIANT RESONANCES OF SPHERICAL NUCLEI BY ELECTRON SCATTERING. Wright, L. E. (Army Research Office, Durham, N. C. Duke Univ., Durham, N. C.); Tuan, S. T.; Weber, H. J. pp 367 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27073 GIANT DIPOLE STATES AND EXCITED GIANT DIPOLE STATES IN ^{12}C, ^{28}Si, AND ^{32}S. Kamimura, M.; Ikeda, K.; Arima, A. (Tokyo Univ.). pp 370 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27074 NUCLEAR RESONANT ABSORPTION OF γ-RADIATION FROM PROTON CAPTURE REACTIONS. de Kock, P. R.; Hough, J. H.; du Toit, Z. B.; Mouton, W. L. (Univ. of Stellenbosch, S. Africa). pp 373 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27075 RADIATIVE CAPTURE OF ^{3}He AND ^{4}He IONS IN HEAVY NUCLEI. Daly, P. J.; Carlson, R. V. (Purdue Univ., Lafayette, Ind.). pp 378 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27076 PHOTOPROTONS FROM Na, P, S, Ca, Mn, AND Fe. Shoda, K. (Tohoku Univ., Sendai); Abe, K.; Ishizuka, T.; Kawamura, N.; Oyamada, Y.; Sung, B. N. pp 382 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27077 PHOTONUCLEAR REACTIONS WITH EMISSION OF SEVERAL NUCLEONS. Bernatowicz, H.; Medicus, H. A. (Rensselaer Polytechnic Inst., Troy, N. Y.). pp 384 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27078 GIANT DIPOLE RESONANCE IN ^{36}Ar. Meyer-Schuetzmeister, L. (Argonne National Lab., Ill.); Gemmell, D. S.; Bearse, R. C.; Puttaswamy, N. G.; Segel, R. E. pp 385 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27079 PHOTO-EXCITATION OF HIGH LYING SINGLE LEVELS USING NEUTRON CAPTURE GAMMA-RAYS. Arad, B.; Ben-David, G.; Schlesinger, Y. (Israel Atomic Energy Commission, Yavne). pp 387 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27080 COUPLED-CHANNEL CALCULATION OF ^{28}Si PHOTOREACTIONS. Marangoni, M.; Saruis, A. M. (CNEN, Bologna). pp 393 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27081 DOUBLE BETA DECAY IN ^{48}Ca AND THE CONSERVATION OF LEPTONS. Bardin, R. K.; Gollon, P. J.; Ullman, J. D.; Wu, C. S. (Columbia Univ., New York). pp 397 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27082 THE DETERMINATION OF ISOSPIN IMPURITIES IN NUCLEAR STATES BY β-DECAY EXPERIMENTS. Coussement, R.; Vanneste, L. (Leuven Univ., Belgium). pp 398 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27083 INVESTIGATION OF THE $^{23}Na(d,\alpha)^{21}Ne$ REACTION. Cox, Richard Severin. Evanston, Ill., Northwestern Univ., 1967. 84p.
Thesis.
An investigation of the $^{23}Na(d,\alpha)^{21}Ne$ reaction was made in order to study the reaction mechanism by which it proceeds. Differential cross sections to the ground and first seven excited states of ^{21}Ne were obtained in 20- to 50-keV steps between 2- and 4.2-MeV bombarding energies at seven angles from 10 to 170° in the laboratory system. The measurements were carried out with energy resolutions of a few kilovolts and to accuracies in the neighborhood of five %. The cross sections exhibited moderate fluctuations as a function of energy over ranges of several hundred kilovolts and analysis in terms of correlation functions indicate that they are not of the "Ericson" type. The partial equilibrium model for nuclear reactions of K. Izumo correctly predicts the spacing of maxima in the cross sections when six or seven nucleons of the compound system are assumed to share the energy of the incoming deuteron. Hence, it is concluded that the $^{23}Na(d,\alpha)^{21}Ne$ reaction proceeds through an intermediate process at these relatively low bombarding energies. (Diss. Abstr.)

27084 MEASUREMENTS AND DWBA ANALYSES OF THE 18.7-MeV DIFFERENTIAL CROSS SECTIONS FOR THE $(\alpha,d_{0,1})$ REACTIONS ON ^{23}Na, ^{27}Al, AND ^{31}P. Srivastava, Brajesh Bahadur. Lafayette, Ind., Purdue Univ., 1967. 154p.
Thesis.
The 18.7-MeV differential cross sections for the $(\alpha,d_{0,1})$ reactions on ^{23}Na, ^{27}Al, and ^{31}P were measured at 5° intervals over the angular range from about 15° to 170°. The deuteron spectra were measured using a spectrometer system which incorporated an $(E \times \Delta E)$ particle identifier, an $(E, \Delta E)$ counter telescope consisting of two silicon surface-barrier detectors, and a multichannel pulse-height analyzer. In the ^{23}Na investigation, one target each of sodium hydride (266 ± 10 μg/cm^2) and metallic sodium

(267 ± 10 μg/cm²) was used. The ^{23}Na, NaH, and the ^{31}P (650 ± 12 μg/cm²) targets were prepared by thermal vacuum evaporation of the material onto a thin Formvar film (<20 μg/cm²). The ^{27}Al target (774 ± 13 μg/cm²) was fabricated from a 0.1 mil commercial aluminum foil. The shapes of the six (α,d) angular distributions measured may be characterized by combinations of the following general features: either (a) well-defined and pronounced oscillatory structure or washed-out undulatory behavior; either strong forward-angle peaking without pronounced backward-angle peaking or the reverse behavior. The shape of the angular distribution in each case suggests a significant direct reaction contribution to the cross section. Distorted-wave Born-approximation analyses of the data were made in terms of Tobocman's zero-range knock-out and stripping models. In the knock-out model the initial (final) nuclear state is described as a two-body system consisting of a deuteron (an alpha particle) bound to a core, and in the stripping model the final nuclear state is described as a deuteron bound to a core made up of the target nucleus. In the analyses of the ^{23}Na data the gross features of both angular distributions could be marginally reproduced by the knock-out model only. Knock-out analysis indicates that both of these $(\alpha,d_{0,1})$ transitions correspond to angular momentum transfers of 2. In the analyses of the ^{27}Al data, except for a good stripping-model fit to the (α,d_1) angular distribution, the fits achieved in the other cases reproduce only the gross features of the experimental angular distributions. The general quality of these fits precludes any reasonably objective conclusion as to whether a knock-out or a stripping model provides a better description of the data. The knock-out analysis indicates that the (α,d_0) reaction corresponds to mixed angular momentum transfers of 2 and 4 while the dominant contributions to the (α,d_1) reaction cross section correspond either to an angular momentum transfer of 4 or to a mixture of 0 and 4. The stripping analysis indicates that in the (α,d_0) and (α,d_1) reactions the dominant contributions correspond to angular momentum transfers of 2 and 4, respectively. The ^{31}P data were analyzed in terms of the knock-out model only and good agreement between the experimental and theoretical angular distributions was achieved. This analysis indicates that the (α,d_0) and (α,d_1) reactions correspond to angular momentum transfers of 2 and 0, respectively. The states of the two-body systems, representing the initial and final nuclear states, which are implied by the analyses of each reaction are discussed. It is concluded that the applicability of Tobocman's zero-range distorted-wave Born-approximation knock-out and stripping formalisms in the description of these (α,d) reactions is marginal. (Disser. Abstr.)

27085 (^{3}He,α) REACTIONS ON INTERMEDIATE MASS NUCLEI. Borlin, David Dee. St. Louis, Washington Univ., 1967. 205p.

Thesis.

In order to investigate the utility of the (^{3}He,α) reaction as a spectroscopic tool in nuclear-structure research, targets of ^{40}Ca, ^{46,48,50}Ti, ^{54}Fe, and ^{64,66,68,70}Zn were bombarded with a 33-MeV ^{3}He beam. The shapes of the resulting angular distributions were used to assign l values to some of the observed levels. Indications of a J-dependent effect were observed for transitions involving a transfer of l-1 or l = 3. Transitions involving l = 3 or 4 were found to be greatly enhanced over those involving lower l values, in direct contrast to other neutron-pickup reactions which enhance the lower l values. The large positive Q-value of the (^{3}He,α) reaction permitted the investigation of regions of high excitation energy in the residual nuclei and the resulting observation of a number of isobaric-analog states. Parameters for use in DWBA calculations were obtained by least-squares optical-model analyses of ^{3}He and alpha scattering data. Spectroscopic factors were extracted from the (^{3}He,α) angular distributions by means of DWBA calculations, which employed finite-range and nonlocality corrections. Although some difficulty was experienced in the DWBA analyses, spectroscopic factors obtained for levels with l = 1,2,3, or 4 are consistent with previously determined values. Both the spectroscopic factors for the isobaric-analog states and also the Coulomb displacement energies exhibited trends which had been previously observed in (p,d) reactions. Consistent trends were established for the occupation numbers of the shell-model orbitals. The (^{3}He,α) reaction was found to be very useful as a spectroscopic tool for the investigation of fp-shell nuclei. However, the difficulties experienced in the present analysis indicate that at the present time this reaction is most useful as a complement to other single-neutron-transfer reactions. (Disser. Abstr.)

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Refer also to abstracts 25441, 25642, 25664, 26739, 26768, 26792, 26832, 26881, 26932, 26938, 26943, 26962, 26963, 26987, 26988, 26993, 26999, 27010, 27025, 27037, 27039, 27055, 27068, 27072, 27075, 27079, 27222, 27239, 27242, 27253, 27261, 27276, 27278, 27318, 27323, 27329, 27336, 27339, 27342, 27364, 27378–27380, and 27382.

27086 (ANL–7375, pp 176–7) NUCLEAR CONSTANTS. (Argonne National Lab., Ill.).

Preliminary results in the program to measure capture cross sections for fast reactor materials and to measure and calculate capture-to-fission ratios for ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{235}U, and ^{238}U in EBR-II as a function of position are reported. (D.C.W.)

27087 (ANL–7405) PHYSICS DIVISION SUMMARY REPORT, OCTOBER–DECEMBER 1967. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 74p. Dep. CFSTI.

Spin-parity assignments for low-energy states in ^{168}Er were made on the basis of an investigation of neutron resonance capture by ^{167}Er; and the neutron single-particle states of ^{243}Cm, ^{245}Cm, ^{247}Cm, ^{249}Cm, ^{241}Pu, ^{243}Pu, ^{235}U, ^{237}U, and ^{239}U were studied using (d,p) and (d,t) reactions. The blocking of charged particles in single crystals was investigated. The development of a gas-handling system for a tandem Van De Graaff accelerator that uses sulfur hexafluoride as the insulating gas is reported. Abstracts of papers that have been presented at meetings and of papers that have been accepted for publication are included. (D.C.W.)

27088 (COO–1051–21) SCATTERING PROBLEMS INCLUDING THE SCATTERING OF PARTICLES BY NUCLEI. Technical Progress Report. McManus, H.; Signell, P.; Hetherington, J. H. (Michigan State Univ., East Lansing). Mar. 1968. Contract AT(11-1)-1051. 6p. Dep. CFSTI.

The spectrum of ^{210}Pb was calculated using the shell model with the Kallio-Kolltveit interaction. The cross section for the interaction $\pi + N \rightarrow \rho + N$ at 2 to 15 GeV/c was calculated using the one-pion-exchange model with absorptive corrections. No agreement with experiment was obtained for the interaction $\pi + N \rightarrow \omega + N$ using the ρ-exchange model with absorptive corrections and form factors. (D.C.W.)

27089 (DP-MS-67-118) ^{238}Pu PRODUCTION PREDICTIONS FROM AVAILABLE NEUTRON CROSS SECTIONS. Hennelly, E. J.; Cornman, W. R.; Baumann, N. P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb. 19, 1968. Contract AT(07-2)-1. 6p. (CONF-680307-2). Dep. CFSTI.

From 2nd Conference on Neutron Cross Sections and Technology, Washington, D. C.

^{238}Pu, a candidate heat source material, is the β-decay product of ^{238}Np ($T_{\frac{1}{2}}$ = 2.1 d) that is made by neutron capture in ^{237}Np. ^{237}Np is a relatively stable irradiation by-product formed in nuclear reactors either by (n,2n) capture in ^{238}U or by successive neutron addition to ^{235}U. A self-consistent set of effective cross sections was derived that, with modern reactor codes, predicts production rates, product isotopic purity, and product yield for a range of thermal reactor spectra. The cross sections are based on existing data that were modified by activation measurements and by analysis of product formation in test sample irradiations. Cross sections for the respective short-lived decay precursors, ^{237}U ($T_{\frac{1}{2}}$ = 6.75 d) and ^{238}Np ($T_{\frac{1}{2}}$ = 2.1 d) were measured in high-flux test irradiations at Savannah River [$\phi > 10^{15}$ n/(cm²)(sec)]. Effective thermal neutron cross sections of ^{237}Np and ^{238}Pu were established by measuring product formation in test irradiations. Activation measurements with ^{236}U, a target precursor to ^{237}Np, indicated discrepancies in the reported value of the resonance integral. The fission cross section of ^{238}Np was independently verified by fission chamber measurements in a zero-power test reactor using samples prepared at high neutron flux. The methods used, in some cases, lead to precise integral cross sections; in others, the results apply best to a particular reactor spectrum. (auth)

27090 (UCRL–17907) RECENT TRANSURANIUM ELEMENT RESEARCH AT BERKELEY. Ghiorso, Albert (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1967. Contract W-7405-eng-48. 30p. (CONF-671055-1). Dep. CFSTI.

From Centenary Symposium, Warsaw, Poland.

The work on the element 102 (nobelium) is reviewed, and the production reactions and decay properties of its isotopes are tabulated. Some experiments on the solution chemistry of nobelium are reported, which indicate that its +2 state is the most stable state. Experimental results are presented on the spontaneous fission of ^{244}Fm. Correlations of various properties with neutron number are used to discuss predicted characteristics for the element 104. Proposed experiments on isotopes of element 104 are described, and the possibility of producing stable nuclides such as ^{310}126 or 114 is considered. The accelerator design Omnitron and its operation modes in accelerating very heavy ions are described. (D.L.C.)

27091 (WANL-TME-574(Rev.1)) NUCLEAR DATA LIBRARY FOR THE FISSION PRODUCT PROGRAM. Trammell, M. R.; Henninger, W. A. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Nov. 17, 1966. 53p. Dep. CFSTI.

A compilation of updated information on the fission products of ^{235}U is presented. The mass number, half-life, decay constant, fission yield, β spectrum, and γ spectrum of each nuclide are included. Tables of decay chains are also provided; the total chain yield is given at the end of each chain. (D.C.W.)

27092 TWO-NUCLEON TRANSFER REACTIONS AND THE FOUR-QUASIPARTICLE TAMM-DANCOFF APPROXIMATION. Gyarmati, B.; Sawicki, J. (International Centre for Theoretical Physics, Trieste, Italy). pp 245 of Contributions, International Conference on Nuclear Structure, September 7-13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

See CONF-670910.

27093 INFLUENCE OF NUCLEAR DEFORMATION ON THE NEUTRON WAVE STRENGTH FUNCTIONS OF HEAVY DOUBLY EVEN ROTOR NUCLEI. Gigas, G. (Atomics International, Canoga Park, Calif.). Nucl. Phys., A112: 527-36(1968).

The neutron s-, p- and d-wave strength functions for 15 heavy doubly even rotor nuclei from ^{226}Ra to ^{244}Cm were calculated with a deformed nucleus optical model using the deformations of Stelson and Grodzins. Repetition of the analyses with reduced deformations, as suggested by considerations of the multipole moments of diffuse-edged charge distributions and the potential scattering radius data, produced an improved agreement with experimental measurements. The reduced deformations were essentially equivalent to the ground-state equilibrium deformations calculated from the Bardeen-Cooper-Schrieffer theory using projected wave functions including an explicit Coulomb term. Comparative analyses with a single-particle vibrator model, as well as a spherical nucleus with a diffuse edge, are presented. (auth)

27094 THE ^{140}La SPECTRUM ACCORDING TO THE UNIFIED MODEL. Heyde, K.; Brussaard, P. J. (Univ., Utrecht). Nucl. Phys., A112: 494-502(1968).

The energy spectrum of the doubly odd nucleus ^{140}La is described in terms of the unified model in intermediate coupling. The phonon energy of the ^{138}Ba core, the coupling strengths between phonon excitations and the proton and neutron single-particle motion, the single-particle energies and the four strengths describing the exchange mixtures of the residual interaction of the odd proton and neutron are considered as free parameters and are determined in a least-squares fitting procedure. The wave functions thus obtained, are used to determine M1 transition rates and (d,p) spectroscopic factors. (auth)

27095 RESONANCE GROUPING STRUCTURE IN NEUTRON-INDUCED SUBTHRESHOLD FISSION OF ^{240}Pu. Migneco, E.; Theobald, J. P. (Central Bureau for Nuclear Measurements, Geel, Belgium). Nucl. Phys., A112: 603-8(1968).

The subthreshold fission cross section of ^{240}Pu was measured in the energy range between 200 eV and 8 keV. The fission spectrum obtained shows a periodical appearance of groups of resonances with particularly high fission widths. The mean fission cross section is higher than the calculated value for p-wave fission. (auth)

27096 DECAY OF ^{94}Tc ISOMERS INTO THE LEVELS OF ^{94}Mo. Aras, Namik K.; Eichler, Eugene; Chilosi, G. G. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A112: 609-24(1968). (ORNL-P-3713).

The energy levels in ^{94}Mo were investigated from the decay of ^{94}Tc isomers using Ge(Li) and NaI(Tl) detectors. The energies of the gamma rays in keV (and relative intensities) from the decay of 52 min ^{94m}Tc are 870.9(100), 993.1(2.6), 1196.3(0.9), 1522.0(5.9) 1868.8(5.8), 2393.0(0.6), 2530.0(0.7), 2740.0(3.8), 3129.2(1.2) and 3793.5(0.1). Gamma-ray energies (and transition intensities) observed in the decay of 5 h ^{94g}Tc are 449.0(27), 531.6(1.2), 702.6 (100), 742.0(1.1), 849.7(100), 870.9(100), 916.2(6.8), 1509.7(0.7), 1591.8(2.4) and 1764.6(0.2). An angular correlation measurement indicated the presence of a second 2^+ state. The results are in partial agreement with the effective interaction calculations of Bhatt and Ball and of Vervier. (auth)

27097 ISOBARIC ANALOG RESONANCES IN THE LEAD REGION. Lenz, G. H.; Temmer, G. M. (Rutgers-The State Univ., New Brunswick, N. J.). Nucl. Phys., A112: 625-53(1968).

The isobaric analog states of the ground and low-lying levels of ^{205}Pb, ^{207}Pb and ^{209}Pb were studied as compound-nucleus resonances in ^{205}Bi, ^{207}Bi and ^{209}Bi by bombarding isotopically enriched targets of ^{204}Pb, ^{206}Pb and ^{207}Pb with protons in the energy range of 11.00 to 16.00 MeV. The resonance parameters were determined by fitting the elastic-scattering excitation functions with optical-model plus isolated-resonance expressions. The elastic-scattering partial widths of the $9/2^+$ analogs of the odd-lead isotopes and the elastic and inelastic partial decay widths of the analog of the ground state of ^{209}Pb are compared with single-particle width estimates determined from a realistic, diffuse-edged potential model. The sensitivity of the single-particle width estimates to the well parameters is discussed. The off-resonance yields to the $5/2^-$, 0.570-MeV state of ^{207}Pb and the 2^+, 0.899-MeV state of ^{204}Pb were determined to be principally due to Coulomb excitation in the region of the ground state analogs of ^{206}Pb and ^{208}Pb. Destructive interference between the Coulomb excitation and resonance processes is observed in the large-angle yields to the latter two states. Striking elastic and inelastic-scattering systematics are seen in the formation and decay of the $9/2^+$ analogs of the odd-lead isotopes and in the decay of the related 5^- and 4^- analogs of ^{209}Pb. Coulomb displacement energies and their isotope shifts deduced from the $9/2^+$ analogs are compared with the predictions of the uniform charge model as well as with a more detailed calculation using shell-model orbitals. (auth)

27098 SPECTROSCOPY OF $^{206\ 207\ 208}Pb$ BY INELASTIC SCATTERING OF 24.5-MeV PROTONS. Saudinos, J.; Vallois, G.; Beer, O. (CEN, Saclay, France). Nucl. Sci. Appl., 3: 22-6(Oct. 1967).

The magnetic analysis of inelastic scattering of the 24.5-MeV protons by $^{206,207,208}Pb$ was done with an energy resolution in the range 18 to 25 keV. In the 4 to 5 MeV excitation energy region, for ^{208}Pb, in addition to the already known 2^+ and 4^+ levels, a 6^+ and an 8^+ level were found. The 2^+, 4^+; 6^+, 8^+ level sequence was found also in ^{206}Pb. For ^{207}Pb, the levels corresponding to the splitting of the 2^+ and 6^+ ^{208}Pb states and one level corresponding to the 4^+, ^{208}Pb state were observed. Within the experimental error, the reduced transition probabilities are equal for each corresponding level in $^{206,207,208}Pb$. (auth)

27099 ANGULAR ANISOTROPY OF FISSION FRAGMENTS IN TERNARY FISSION OF ^{235}U INDUCED BY 3-MeV NEUTRONS. Nadkarni, D. M. (Bhabha Atomic Research Centre, Bombay). Nucl. Phys., A112: 241-56(1968).

The values of angular anisotropy of fragments in binary and ternary fission of ^{235}U induced by 3-MeV neutrons were determined with two independent methods. In the first method fission fragments and long range alpha particles were detected with a gridded ionization chamber and a CsI crystal respectively and in the second method semiconductor detectors were used to detect fission fragments and long-range alpha particles. The values of $N(0°)/N(90°)$ for cases of binary and ternary fissions are found to be different. The probability for emission of long-range alpha particles in 3-MeV neutron induced fission is found to be lower than that in thermal neutron induced fission. A decrease in the average single fragment kinetic energy of ternary fragments compared to that of binary fragments is observed in 3-MeV neutron induced fission similar to that in thermal neutron fission. It is shown that on the basis of the angular distribution of long range alpha particles and ternary fragments it is possible to learn at what stage in the fission process the long range alpha particles are emitted. (auth)

27100 AVERAGED GAMMA-RAY TRANSITION STRENGTHS IN keV NEUTRON CAPTURE. Allen, B. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Sci. Appl., 3: 64-9(Oct. 1967).

Systematic trends in gamma-ray transition probabilities can be deduced from the results of a large number of measurements of thermal neutron capture or of capture at individual low-lying resonances. The broad distribution ($\nu = 1$) for individual partial widths requires averaging of 20 or more values before the mean widths have sufficient statistical accuracy. In order to avoid such large number of measurements, it is possible to obtain the same result by observing the average transition probability for a large number of unresolved resonances. Allowances must be made, however, for the contribution by resonances of different J^π values. It may be shown that suitable cases exist for study using 30 + 10-keV neutrons from the $Li^7(p,n)$ reaction and that averaging over 100 or more resonances is then possible. Measurements were made using a 10-ns pulsed proton beam incident on a thin lithium target to allow time-of-flight studies of neutron capture in the 30-keV energy region. Timing was used to separate neutron capture events from other unwanted gamma-ray events. Germanium or NaI detectors were used to measure the gamma-ray spectra from targets of Hg, Pr, etc. The results are analyzed using the existing knowledge of the low-lying excited states in the product nuclei. Information is obtained on the energy dependence of average transition rates, although this energy dependence can not be isolated from nuclear properties which also affect the observed results. (auth)

27101 COMPARISON BETWEEN THE TWO- AND FOUR-QUASIPARTICLE TAMM-DANCOFF APPROXIMATIONS FOR

EVEN-PARITY STATES OF EVEN TIN ISOTOPES CALCULATED WITH FINITE-RANGE FORCES. Ottaviani, P. L.; Savoia, M.; Sawicki, J. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Sci. Appl., 3: 27-35(Oct. 1967).

The quasiparticle second Tamm-Dancoff (QSTD) theory is applied to the study of even-parity states of even tin isotopes and is compared with the quasiparticle Tamm-Dancoff (QTD) theory. Numerical computations were performed with several Gaussian and P_2 residual interaction potentials. In contrast to previous results with a delta force, reasonable finite-range forces permit accounting for the 0^+ states as well as for the 2^+ and 4^+ states. Four-quasiparticle correlations are included in the ground state. The spurious states of the nucleon number operator are projected out. While the first excited 2_1^+ and 4_1^+ states are generally of almost pure two-quasiparticle character, the first excited 0^+ state is quite of the 2 qp-4 qp mixed type. The E2 transition probabilities and Q_2, the quadrupole moments of the 2_1^+-states, are calculated and discussed. (auth)

27102 DECAY SCHEME OF ^{124}Sb. Zirnheld, J. P. (Univ., Strasbourg); Henck, R. J. Phys. (Paris), 29: 144-8(Feb.-Mar. 1968). (In French).

The γ-ray spectrum of ^{124}Sb was re-investigated by means of Ge(Li) counters. The accuracy obtained in energy measurements is about 0.5 keV. The $\gamma-\gamma$ coincidence spectra were studied with a slow-fast system utilizing two Ge(Li) detectors. The discussion of the results leads to a modified level scheme with an additional level at 2,773 keV. (auth)

27103 FORM FACTOR OF THE 473-keV β TRANSITION ^{94}Nb → ^{94}Mo. Hocquenghem, J. C.; Andre, S.; Lisud, P. (Faculte des Science, Grenoble, France. CEN, Grenoble, France). J. Phys. (Paris), 29: 138-40(Feb.-Mar. 1968). (In French).

The shape of the β^- decay of ^{94}Nb (ground level) to ^{94}Mo (1.574 MeV excited level) was investigated by means of a Siegbahn-Slätis-type magnetic spectrometer. The maximum energy was found to be 473 ± 3 keV. The shape factor is not in agreement with a unique second-forbidden transition; the 6^+ spin value of the ground level in ^{94}Nb is confirmed. This shape-factor measurement, with the $\beta-\gamma$ angular correlation data, thus allows the determination of the β transition nuclear matrix elements. (auth)

27104 LEVEL DENSITY OF THE DEFORMED RARE-EARTH NUCLEI. Owens, R. O.; Towle, J. H. (AWRE, Aldermaston, Eng.). Nucl. Phys., A112: 337-59(1968).

The energy spectra of neutrons inelastically scattered at 90° by 15 elements between In and Bi were measured for incident neutron energies of 5.0, 6.0, and 7.0 MeV using time-of-flight techniques. The energy dependence of the level density was obtained for each element, and the data are fitted quite well by the independent-particle model $w(U) \propto U^{-2} \exp 2(aU)^{\frac{1}{2}}$, although nuclei near shell closures are better described by a constant nuclear temperature. The level density parameters a obtained are in agreement with theoretical expectations, but are significantly lower than those obtained from slow neutron resonance spacings for the deformed nuclei studied, although reasonable agreement is obtained for nuclei outside the deformed region. This conflict is resolved if a modification to the independent-particle model proposed by Ericson is adopted to explain the close resonance spacings observed in the deformed nuclei. (auth)

27105 NEUTRON-INDUCED FISSION CROSS SECTION OF ^{232}U. Auchampaugh, G. F.; Bowman, C. D.; Evans, J. E. (Univ. of California, Livermore). Nucl. Phys., A112: 329-36(1968). (UCRL-70920).

The neutron-induced fission cross section of ^{232}U was measured from 5 to 1900 eV. This is the only doubly even target known which undergoes substantial resonance fission. Only one spin state is excited, and only one open fission channel is expected. An attempt was made to fit the data using the Reich and Moore formula for a single-fission channel. The rather poor quality of the fit suggests that a one-channel theory for fission in ^{232}U is inadequate, which is in agreement with earlier conclusions from total cross-section measurements. (auth)

27106 THE DECAY OF ^{159}Gd. Hill, John C.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A111: 457-68(1968).

Precision energy measurements on four gamma rays in the ^{159}Gd → ^{159}Tb decay were performed with a 2 m curved-crystal spectrometer. Energies of the other gamma rays and all gamma intensities were determined with a Ge(Li) spectrometer. A level scheme is proposed for ^{159}Tb which includes a level at 854 keV. The status of the 617 keV doublet has been clarified. On the basis of these measurements a proposal is made concerning the nature of the 854 keV level. (auth)

27107 TRANSITION MULTIPOLARITIES IN ^{143}Pr AND ^{141}Pr. Gelletly, W.; Geiger, J. S.; Graham, R. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 168: 1336-43 (Apr. 20, 1968).

Measurements of L-shell internal conversion line intensity ratios are reported for the 57.37- and 293.3-keV transitions in ^{143}Pr and for the 145.43-keV transition in ^{141}Pr. The measurements were made, using a 100-cm-radius iron-free $\pi\sqrt{2}$ double-focusing β spectrometer at a resolution setting of 0.05% in momentum. Comparison with theoretical L-shell internal conversion coefficient ratios gives multipolarities for the 57.37-keV γ ray of (99.85 ± 0.03)% M1 + (0.15 ∓ 0.03)% E2 and for the 293.3-keV γ ray of (63 ± 4)% M1 + (37 ∓ 4)% E2. The measured K-conversion coefficient for the 57.37-keV transition is 5.64 ± 0.34. Analysis of the ^{143}Pr results in combination with the 293- and 57-keV $\gamma-\gamma$ angular correlation results of other experimenters indicates a $\frac{5}{2}$+ assignment for the 57.37-keV level and a $\frac{3}{2}$+ assignment for the 350.7-keV level in ^{143}Pr. The multipolarity of the 145.43-keV transition in ^{141}Pr is (99.58 ± 0.08)% M1 + (0.42 ∓ 0.08)% E2. (auth)

27108 $^{90\ 92\ 94}$Zr(p,p') REACTIONS AT 12.7 MeV. Dickens, J. K.; Eichler, E.; Satchler, G. R. (Oak Ridge National Lab., Tenn.). Phys. Rev., 168: 1355-72(Apr. 20, 1968).

The elastic and inelastic scattering of 12.7-MeV protons from ^{90,92,94}Zr was studied. Angular distributions for the elastic and 40 inelastic groups were measured. An optical-model analysis of the elastic scattering was performed. The inelastic scattering was interpreted, using the usual "collective"-model interaction and the distorted-wave approximation. Multipolarities L were assigned where possible, and strength parameters β_L were deduced. The inelastic scattering to some states was also compared with the predictions of the shell model, using a simple two-body interaction of Yukawa type and including the effects of core polarization. Reasonable agreement was obtained, although the angular distributions for the 0^+ and 3^- excitations imply that a more sophisticated effective interaction is required. (auth)

27109 FAST-NEUTRON SCATTERING FROM Ta, Re, AND Pt. Smith, A. B.; Guenther, P. T.; Whalen, J. F. (Argonne National Lab., Ill.). Phys. Rev., 168: 1344-55(Apr. 20, 1968).

The scattering of neutrons with energies of ≈1.5 MeV from the elements Ta, Re, and Pt was experimentally studied. Elastic and inelastic neutron-scattering angular distributions were determined at incident-neutron-energy intervals of ≈20 keV throughout the range 0.3 to 1.5 MeV. Time-of-flight measurements were made concurrently at eight or more scattering angles between 25 and 155° with sufficient scattered-neutron-energy resolution to separate the elastically scattered component from most inelastically scattered neutron groups. Differential inelastic scattering cross sections corresponding to the excitation of the following states were observed: in Ta at 144 ± 10 (doublet), 313 ± 15, 506 ± 20, 620 ± 20, 720 ± 20, and 930 ± 25 keV; in Re at 132 ± 10, 219 ± 15, 313 ± 15, 387 ± 18, 518 ± 20, 637 ± 20, 767 ± 25, 865 ± 25, 963 ± 25, 1060 ± 25 and 1135 ± 25 keV; and in Pt at 130 ± 20, 214 ± 20, 348 ± 15, 420 ± 15, 620 ± 20, 719 ± 15, 838 ± 25, and 935 ± 20 keV. The experimental results were compared with calculations based upon the optical model and the Hauser-Feshbach formula including corrections for resonance-width fluctuations. The experimentally observed level structure is discussed in the context of single-particle and rotational states of deformed nuclei. (auth)

27110 SHELL-MODEL THEORY OF ^{206}Pb. II. True, William W. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., 168: 1388-92(Apr. 20, 1968).

The eigenvalues and eigenfunctions of the low-lying levels of ^{206}Pb were calculated using a singlet-even potential and a P_τ-type force which is known to arise when the particle states are weakly coupled to a phonon. All the neutron orbitals between N = 82 and N = 126 were considered. The ground-state wave function is found to be in much better agreement with experiment than has been the case for previous calculations. (auth)

27111 ENERGY LEVELS OF ^{167}Er, ^{169}Er, AND ^{171}Er FROM (d,p) REACTIONS. Harlan, R. A. (Univ. of Arkansas, Fayetteville. Florida State Univ., Tallahassee); Sheline, R. K. Contracts AT(40-1)-2434; AT(40-1)-3235. Phys. Rev., 168: 1373-87(Apr. 20, 1968).

High-resolution (d,p)-reaction spectroscopy was used to study the energy levels of ^{167}Er, ^{169}Er, and ^{171}Er to excitation energies greater than 2.5 MeV. The energy resolution for proton groups observed in a magnetic spectrograph was ≈0.08%. The measured Q values are 4209 ± 10, 3773 ± 10, and 3450 ± 10 keV for ^{166}Er(d,p)^{167}Er, ^{168}Er(d,p)^{169}Er, and ^{170}Er(d,p)^{171}Er reactions, respectively. A large number of the observed energy levels were assigned to specific Nilsson orbitals and their superimposed rotational bands. Generally, the energy systematics of the Nilsson

bands qualitatively follow expectations of the Nilsson model. The energy systematics, decoupling parameters, and cross sections suggest considerable mixing between γ-vibrational bands and certain Nilsson states with the same spin and parity. The strongest indications in these data for mixings of collective and intrinsic states involve the $\frac{1}{2}-[510]$ band. In ^{167}Er and ^{169}Er, this band appears to be considerably lowered from the position expected by energy systematics, and appears to have a lower cross section than expected for a pure $\frac{1}{2}-[510]$ band. (auth)

27112 ELECTRON-INDUCED FISSION IN ^{238}U, ^{209}Bi, AND ^{181}Ta. Bowman, H. R. (Univ. of California, Berkeley); Gatti, R. C.; Jared, R. C.; (and others). Contract W-7405-eng-48; NONr-225(67). Phys. Rev., 168: 1396-8(Apr. 20, 1968). (HEPL-538).

The fission cross sections of ^{238}U and ^{209}Bi induced by 250- and 500-MeV electrons were measured using mica detectors. Pulse-height distributions of the fission fragments from ^{238}U were also measured using semiconductor detectors, and the distributions showed two peaks characteristic of excitation energies less than about 40 MeV. Several methods were used to prove that the observed fission events were induced by electrons and not by bremsstrahlung or background radiations. Preliminary measurements of fission-fragment angular distributions show less than 10% deviations from isotropy. (auth)

27113 REDETERMINATION OF THE DECAY ENERGY OF ^{133}Ba. McDonnell, Michael; Ramaswamy, M. K. (Fordham Univ., Bronx, N. Y.). Phys. Rev., 168: 1393-6(Apr. 20, 1968).

The L_1/K electron capture ratio for the decay of ^{133}Ba to the 437-keV level of ^{133}Cs was determined using a modified version of the sum-coincidence technique. The L and K x-ray intensities following electron capture were measured in coincidence with the 437-keV sum peak arising from the coincidence summing of the 356-81-keV γ cascade in ^{133}Cs. The measured L_1/K ratio of 0.67 ± 0.15 leads to a decay energy of 62 keV to the 437-keV level. This value is closer to the recent determination of Schulz than to the earlier ones. (auth)

27114 ODD-PARITY STATES OF EVEN TIN ISOTOPES IN THE QUASIPARTICLE SECOND TAMM-DANCOFF APPROXIMATION. Rimini, A. (Univ., Trieste, Italy); Sawicki, J.; Weber, T. Phys. Rev., 168: 1401-5(Apr. 20, 1968).

The negative-parity 3^-, 5^-, 6^-, and 7^- states of the even isotopes of tin are studied with the quasiparticle second Tamm-Dancoff (QSTD) theory which treats the two- and four-quasiparticle excitations on the same footing. The static magnetic moments and the Eλ transition probabilities are calculated. The QSTD eigenvalues, and particularly the QSTD eigenvectors, obtained with phenomenological residual nuclear forces are found to be more sensitive to the residual nuclear force and to the unperturbed single-particle energy levels assumed than are the corresponding results for the even-parity states of the same isotopes. It is shown, however, that a semiquantitative agreement of the QSTD predictions with experiment can be achieved. In particular, rather good agreement is obtained in one case with the observed values of the static magnetic moments of the 5_1^- states of ^{116}Sn and ^{120}Sn. Corresponding calculations with a realistic nucleon-nucleon potential are most desirable. (auth)

27115 AVERAGE BETA ENERGY OF ^{241}Pu BY CALORIMETRY. Oetting, F. L. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. Phys. Rev., 168: 1398-1401(Apr. 20, 1968).

The average β energy resulting from the β decay of plutonium-241 was determined with a Calvet microcalorimeter by a technique unique to calorimetry. The average β energy obtained with the calorimeter is 5.78 ± 0.31 keV. This is compared to the average β energy as obtained by integrating the β spectrum taken from the literature. (auth)

27116 MEAN LIFE OF THE 538-keV STATE IN ^{103}Rh. Rama Rao, M. T.; Ramamurty, V. V.; Lakshminarayana, V. (Andhra Univ., Waltair, India). Phys. Rev., 168: 1406-8 (Apr. 20, 1968).

The mean life of the 538-keV state in ^{103}Rh is determined, using a time-to-pulse-height converter of the Green and Bell type and of resolving time 0.76 nsec. RCA 6810A photomultipliers in conjunction with NE 102 plastic phosphors are employed for β and γ detection, and a β-γ coincidence method together with the centroid-shift technique is used to obtain the mean life as $5.6 \pm 1.8 \times 10^{-11}$ sec. This value of the mean life is employed to estimate the γ transition probabilities for the 498-keV transition, assuming it to be pure M1, 50% M1 + 50% E2, and pure E2, and is compared with the single-particle estimates. The 538-keV state does not seem to arise from a $(g_{\frac{9}{2}})^{3 \text{ or } 7}$ configuration. (auth)

27117 LIFETIMES OF THREE LOW-LYING EXCITED STATES IN ^{117}In. Chilosi, G. (Oak Ridge National Lab., Tenn.); Van Hise, J. R.; Tang, C. W. Contract W-7405-eng-26. Phys. Rev., 168: 1409-14(Apr. 20, 1968). (ORNL-P-3375).

The lifetimes of three low-lying excited states in ^{117}In were measured by delayed-coincidence techniques using a time-to-amplitude converter. These states at 748, 659, and 587 keV are fed by β^- decay from the $s_{\frac{1}{2}}$ ground state of ^{117}Cd (2.4 h). The measured half-lives are 4.6 ± 0.3, 59.7 ± 2.0, and 0.17 ± 0.03 nsec, respectively. All three levels de-excite directly to the 314-keV $p_{\frac{1}{2}}$ isomeric state but not to the $g_{\frac{9}{2}}$ ground state of ^{117}In. A comparison of the partial half-lives with the corresponding single-particle estimates has been performed assuming E1, M1, or E2 character for the transitions. Higher multipolarities are ruled out by the short half-lives of the levels. Log ft values of transitions from ^{117}Cd indicate negative parities for the three levels, and systematics of known γ-ray transition probabilities suggest M1-E2 character for all the transitions involved in their de-excitation. However, when considered as pure E2, the transitions from the 748- and 659-keV levels are delayed by factors ranging from about 3 to 20 compared with the single-particle transition probabilities, whereas when they are considered as pure M1 transitions, delays of the order of 10^4 result. On the other hand, the 274-keV transition from the 587-keV level is enhanced by a factor of about 60 when assumed as pure E2. The possibility of considering this level as a member of the doublet obtained by coupling the 2^+ phonon excitation of the ^{116}Cd or ^{118}Sn even-even core to the $p_{\frac{1}{2}}$ single-particle state is discussed. (auth)

27118 LEVEL SCHEME OF ^{93}Mo INVESTIGATED BY THE NEUTRON DECAY OF ISOBARIC ANALOGUE RESONANCES. Finckh, E.; Jahnke, U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A111: 338-52(1968).

The neutron decay of isobaric analog resonances excited in the compound nucleus ^{94}Mo by bombarding ^{93}Nb with protons is investigated by the time-of-flight method. The statistical model is successfully applied to describe the branching ratio to different final states in ^{93}Mo. From comparison of the calculated transition probability with the measured neutron intensity, spin and parity of some ^{93}Mo states are deduced and the spin-parity assignment of the isobaric analog states in ^{94}Mo is confirmed. The Q-value of the ^{93}Nb(p,n) reaction and the excitation energy of 29 levels in ^{93}Mo are given. (auth)

27119 GAMMA SPECTRA AND REACTION CROSS SECTIONS FOR THE CAPTURE OF 14-MeV NEUTRONS IN ^{27}Al AND ^{127}I. Dinter, H. (Univ., Erlangen, Ger.). Nucl. Phys., A111: 360-70 (1968). (In German).

The capture of 14-MeV neutrons produces nuclei in a state with an excitation energy in the region of the giant resonance. Gamma-ray spectra of such radiative capture reactions give information about the contribution of "collective capture processes" to the reaction cross section as well as about the contribution of statistical and direct processes. For this purpose, the gamma-ray spectra of the reactions ^{27}Al(n,γ)^{28}Al and ^{127}I(n,γ)^{128}I were investigated with 14 MeV neutrons. From these spectra, the cross sections and the quantities $d\sigma/dE_\gamma$ were determined and compared with theoretical predictions. (auth)

27120 DEPENDENCE OF INTERNAL CONVERSION IN ^{169}Tm ON THE CHEMICAL ENVIRONMENT AND ITS APPLICATION TO THE MOESSBAUER ISOMER SHIFT. Carlson, Thomas A.; Erman, Peter; Fransson, Kjell. (Research Inst. for Physics, Stockholm). Nucl. Phys., A111: 371-84(1968).

The electron spectrum arising from internal conversion in ^{169}Tm was examined as a function of the chemical environment. The ^{169}Er ions were imbedded after passage through an isotope separator into a variety of targets including tungsten metal, WO_3 and Tm_2O_3. The electron spectra were measured with a double-focusing electron spectrometer. The relative intensities of the converted electrons with the exception of the outermost P_I shell were insensitive to the chemical media. The analysis gave M_I 100, M_{II} 37 ± 1, M_{III} 38 ± 1, M_{IV} 0.9 ± 0.2, M_V 1.0 ± 0.2, N_I 22.1 ± 0.6, N_{II} 6.4 ± 0.3, N_{III} 7.6 ± 0.2, $N_{IV,V}$ 0.20 ± 0.02, O_I 3.7 ± 0.1, $O_{II,III}$ 2.08 ± 0.06. This is in agreement with theory based on an M1 transition with 0.108% E2 admixture. The intensity of the P_I shell, however, was found to be dependent on the chemical surroundings. The ratio of P_I/O_I intensities were 0.056 ± 0.007, 0.035 ± 0.006, and 0.030 ± 0.006, respectively, for W, Tm_2O_3 and WO_3. This indicates that the P_I conversion in the oxides is 38% (Tm_2O_3) and 46% (WO_3) lower than in the metal. The internal conversion coefficients were compared with electron densities obtained from relativistic wave functions for Tm and Tm ions. From this comparison, it was possible to estimate the changes in electron densities at the nucleus. A discussion is made of the impor-

tance of these electron density measurements in evaluating Mössbauer isomer shifts. The transition energy is found to be 8.401 ± 0.008 keV. (auth)

27121 SPECTROSCOPIC FACTORS FROM ^{208}Pb(d,p)^{209}Pb AT 8.00 MeV. Crawley, G. M.; Rao, B. V. Narasimha; Powell, D. L. (Australian National Univ., Canberra). Nucl. Phys., A112: 223-30(1968).

The reaction ^{208}Pb(d,p)^{209}Pb was studied in the region below the Coulomb barrier in order to investigate the accuracy with which spectroscopic factors can be obtained from this process. Both distorted-wave and analytic calculations are discussed. The dependence of the spectroscopic factors on the geometry of the bound-state well leads to a value of 6.06 fm for the root-mean-square radius of the nuclear potential. This is rather larger than the value obtained from electron scattering measurements. (auth)

27122 PRECISION MEASUREMENT OF BETA-RAY END-POINT ENERGIES: ^{60}Co, ^{137}Cs, AND ^{204}Tl. Wolfson, J. L.; Collier, A. J. (Univ. of Saskatchewan, Regina). Nucl. Phys., A112: 156-60(1968).

Using a high resolving power, iron-free spectrometer, precise measurements were performed of the end-point energies of the beta-ray spectra from ^{60}Co, ^{137}Cs (low-energy spectrum), and ^{204}Tl. The values obtained were 317.88 ± 0.10, 511.63 ± 0.84, and 763.47 ± 0.22 keV, respectively. (auth)

27123 ABSOLUTE E1, ΔK = 0 TRANSITION RATES IN ODD-MASS Pm AND Eu ISOTOPES. Malmskog, S. G. (Aktiebolaget Atomenergi, Studsvik, Sweden). Ark. Fys., 35: 237-53(1968).

The half-life of the $\frac{5}{2}^-$ (532) intrinsic state in ^{151}Pm, ^{153}Eu, and ^{155}Eu were determined by the delayed coincidence method. The absolute E1, ΔK = 0 transition probabilities between the $\frac{5}{2}^- \rightarrow \frac{5}{2}^+$ (413) intrinsic states were deduced and were compared with theoretical predictions, using the Nilsson model as a starting point. The effect on the predicted transition probabilities obtained by adding pairing correlations and Coriolis coupling were also studied. It was found that the experimental transition rates, which are still strongly enhanced, can not be explained by these contributions alone. It is therefore suggested that collective dipole contributions like those arising through the octupole excitations are of importance. (auth) (Swed)

27124 ABSOLUTE M1 AND E2 TRANSITION PROBABILITIES IN ^{233}U. Malmskog, S. G.; Hoejeberg, M. (Aktiebolaget Atomenergie, Studsvik, Sweden). Ark. Fys., 35: 197-218(1968).

Using the delayed coincidence technique, the half-lives for the 311.9-, 340.5-, 398.6-, and 415.8-keV levels in ^{233}U were determined to be $1.20 \pm 0.15 \times 10^{-10}$, $5.2 \pm 1.0 \times 10^{-11}$, $5.5 \pm 2.0 \times 10^{-11}$, and $< 3 \times 10^{-11}$ sec, respectively. From these half-life determinations, together with previously known electron intensities and conversion coefficients, 22 reduced B(M1) and B(E2) transition probabilities (including 9 limits) were deduced. The rotational transitions give information on the parameters δ and g_K/g_R. The experimental M1 and E2 transition rates between members of different bands were analyzed in terms of the predictions of the Nilsson model, taking into account pairing correlations and Coriolis coupling effects. (auth) (Sweden)

27125 ON THE MAGNETIC PROPERTIES OF THE K = 1 ROTATIONAL BAND IN ^{188}Re. Malmskog, S. G.; Hoejeberg, M. (Aktiebolaget Atomenergi, Studsvik, Sweden). Ark. Fys., 35: 229-36(1968).

The transitions in the decay of the 18.6-min ^{188}Re isomer were studied with a Ge(Li) detector. Two new weak gamma-ray transitions of 156 and 169 keV were found and were interpreted as cross-over transitions. From a delayed coincidence experiment using a double-lens electron-electron coincidence spectrometer, the half-life of the first excited 63.6-keV level in ^{188}Re was determined to be $T_½ = 56 \pm 7$ psec. The half-lives of the first excited 2^+ levels in ^{186}Os and ^{188}Os were also measured and were found to be 0.81 ± 0.03 and 0.68 ± 0.03 nsec, respectively. (auth) (Sweden)

27126 ON THE l-DEPENDENCE OF STRIPPING EXCITATION FUNCTIONS. Hering, W. R.; Dost, M. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A111: 561-8(1968).

It is shown that the measurement of the slope of (d,p) excitation functions at low energies provides a possibility to determine transferred orbital angular momenta l. The method is tested in the reaction ^{208}Pb(d,p)^{209}Pb, where the l-values are known. (auth)

27127 DECAY OF A NEW 26 ns ISOMERIC STATE IN ^{155}Gd. Bonitz, M.; Hansen, N. J. S. (Univ. of Copenhagen). Nucl. Phys., A111: 551-60(1968).

The decay of a 26 ns isomeric state at 68 keV in ^{155}Gd populated in the reaction ^{154}Gd(d,p)^{155}Gd was investigated by delayed coincidence techniques. The most likely Nilsson assignment is $\frac{5}{2}^+|642|$. The decay proceeds by K-allowed, twice n_z-forbidden E1 transitions to the $\frac{3}{2}^-|521|$ ground and first rotational states, respectively. The transition to the ground state has a Nilsson hindrance factor of 41, and the branching ratio of the E1 transitions deviates strongly from the prediction based on the Alaga rule. (auth)

27128 ISOMER RATIOS FOR ^{87m}/^{87}Y FORMED BY ^{90}Zr(d,αn) REACTION. Fanchiotti, H.; Andrade, O.; Mocoroa, A.; Nassiff, S. J. (Univ. Nacional, La Plata, Argentina. Comision Nacional de Energia Atomica, Buenos Aires). Radiochim. Acta, 8: 121-2 (Dec. 1967).

Isomeric cross-section ratios were measured for the ^{90}Zr(d,α n) reaction in which the ^{87m}/^{87}Y isomeric pair is produced. It was found that the isomer ratios increase with increasing bombarding energy between the threshold energy and 27.4 MeV. (auth)

27129 AN ISOMER OF ^{139}Nd WITH A 29.7-MIN HALF-LIFE. Lange, J.; Muenzel, H.; Leitl, I. (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 8: 123-4(Dec. 1967). (In German).

A new activity which decays with a half-life of 29.7 min by emission of positrons and 0.41-MeV γ radiation was produced by deuteron irradiation of praseodymium. This activity is assigned to the ground state of ^{139}Nd. (auth)

27130 THE THERMAL NEUTRON CROSS SECTIONS AND THE RESONANCE INTEGRALS OF ^{196}Hg AND ^{202}Hg. Kim, J. I.; Adams, F. (Univ., Ghent). Radiochim. Acta, 8: 165-9(Dec. 1967).

By neutron activation measurements under a cadmium filter, with gold as a standard monitor, the thermal neutron cross sections of the ^{196}Hg(n,γ)^{197m}Hg, ^{196}Hg(n,γ)^{197}Hg, and ^{202}Hg(n,γ)^{203}Hg reactions were measured and were found to be 106.7, 3092, and 5.04 barn, respectively. For the resonance integrals for the same reactions we found the values 58.9, 413 and 4.99 barn. (auth)

27131 COLLECTIVE STATES OF ^{114}Cd EXCITED BY INELASTIC SCATTERING OF 55-MeV PROTONS. Koike, M.; Nonaka, I.; Kokame, J.; Kamitsubo, H.; Awaya, Y.; Wada, T.; Nakamura, H. (Tokyo Univ.). Phys. Lett., 26B: 287-90 (Feb. 5, 1968).

Vibrational states of ^{114}Cd were investigated with inelastic scattering of 55-MeV protons. The angular distributions for the 0.50-, 1.95-, and 2.39-MeV states were well reproduced with l = 2, 3 and 4 DWBA calculations, respectively, based on single-phonon excitation. (auth)

27132 CORE POLARISATION AND QUASIPARTICLE THEORIES OF EVEN TIN ISOTOPES WITH A REALISTIC NUCLEON–NUCLEON FORCE. Gmitro, M.; Hendekovic, J.; Sawicki, J. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett., 26B: 252-6(Feb. 5, 1968).

Two- and four-quasiparticle theories with the nucleon-nucleon potential of Tabakin are applied to study the even-parity states of the even tin isotopes. The core polarization correction defined by Kuo and Brown are found to be most important in reproducing the existing experimental data. (auth)

27133 ISOMER SHIFT OF THE 83.4-keV ROTATIONAL TRANSITION OF ^{153}Eu AND INTERBAND MIXING. Atzmony, U.; Bauminger, E. R.; Froindlich, D.; Hess, J.; Ofer, S. (Hebrew Univ., Jerusalem). Phys. Lett., 26B: 613-14(Apr. 15, 1968).

From a measurement of the isomer shift of the 83.4-keV rotational transition of ^{153}Eu, a negative value for $\delta\langle r^2\rangle = \langle r^2\rangle_{83.4} - \langle r^2\rangle_{gr}$ was obtained. This result is qualitatively accounted for by Kerman's theory of band mixing. (auth)

27134 EFFECT OF ENVIRONMENT ON THE HALF-LIFE OF ^{235m}U. Neve de Mevergnies, M. (CEN-SCK, Mol, Belg.). Phys. Lett., 26B: 615-17(Apr. 15, 1968).

^{235m}U sources were prepared by collecting the recoil nuclei from a ^{239}Pu deposit. The ^{235m}U half-life varies strongly with the collecting conditions. (auth)

27135 SHELL-MODEL EFFECTIVE INTERACTION STUDIES IN THE A = 90 REGION. Ball, J. B.; Preedom, B. M.; Cates, M. R.; Newman, E. (Oak Ridge National Lab., Tenn.). pp 69 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

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27136 THE LEVEL STRUCTURE OF ^{210}Bi AND THE REACTION MATRIX THEORY. Nishibori, Yutaka (Kyoto Univ.). pp 70 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

See CONF-670910.

27137 AN ANALYSIS OF PROPERTIES OF LOW-LYING LEVELS IN ^{131}I. Choudhury, D. C. (Polytechnic Inst. of Brooklyn). pp 90 of Contributions, International Conference on Nuclear

Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27138 EVIDENCE FOR LARGE INERTIAL PARAMETER OF HIGH-LYING ROTATIONAL BANDS IN ^{182}W. Wahlborn, S. (Royal Inst. of Tech., Stockholm. Research Inst. for Physics, Stockholm); Malmskog, S. G. pp 97 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27139 RV-MODEL PREDICTIONS FOR E2 TRANSITION PROBABILITIES. Abecasis, S. M.; Bosch, H. E. (IIAE, DINFIA, Buenos Aires). pp 98 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27140 NUCLEAR STRUCTURE STUDIES OF NUCLEI NEAR N = 50 WITH (p,d) AND (p,t) REACTIONS. II. Taketani, Hiroshi; Adachi, Minoru; Yoshida, Yoshiteru; Ogawa, Masao; Ashibe, Kusuo (Tokyo Inst. of Tech.). pp 124 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27141 THE (^{3}He,d) REACTION ON ^{88}Sr, ^{90}Zr, AND ^{92}Mo NUCLEI. Bassani, G.; Picard, J.; Souchere, G. (CEN de Saclay, France). pp 126 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27142 SPECTROSCOPIC STUDIES IN N = 51 NUCLEI. Bassani, G.; Picard, J.; Saunier, N.; Souchere, G. (CEN de Saclay, France). pp 127 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27143 (d,^{3}He) REACTION ON EVEN TIN NUCLEI. Bruge, G.; Bussiere, A.; Conjeaud, M.; Faivre, J. C.; Harar, S.; Thuriere, E. (CEN de Saclay, France. Institut de Physique Nucleaire, Orsay, France). pp 128 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27144 LEVEL STRUCTURE OF Sn ISOTOPES BY (p,d), (p,t), AND (p,p') REACTIONS WITH 55-MeV PROTONS. Yagi, K.; Ishimatsu, T.; Saji, Y.; Ishizaki, Y.; Matoba, M.; Nakajima, Y.; Huang, C. Y. (Tokyo Univ.). pp 130 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27145 (^{3}He,d) REACTIONS ON EVEN TIN NUCLEI. Conjeaud, M.; Harar, S.; Bassani, G.; Cassagnou, Y.; Picard, J. (CEN de Saclay, France). pp 131 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27146 THE SINGLE-HOLE STATES IN THE 50 < N ≤ 126 SHELL BY (p,d) REACTIONS. Yagi, K.; Ishimatsu, T.; Saji, Y.; Ishizaki, Y. (Tokyo Univ.). pp 132 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27147 THE (p,t) REACTIONS ON $^{150\ 152\ 154}$Sm. Ishizaki, Y.; Yoshida, Y.; Saji, Y.; Ishimatsu, T.; Yagi, K.; Matoba, M.; Huany, C. Y.; Nakajima, Y. (Tokyo Univ.). pp 133 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27148 EXPERIMENTAL STUDY OF NEUTRON LEVELS IN ODD Yb ISOTOPES THROUGH (d,p) REACTIONS. Gastebois, J.; Barloutaud, M.; Laget, J. M.; Rey, J.; Quidort, J.; Fernandez, B. (CEN de Saclay, France). pp 134 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27149 COLLECTIVE VIBRATIONAL STATES IN DEFORMED NUCLEI A = 150–186. Elbek, B.; Grotdal, T.; Nyboe, K.; Tjoem, P. O.; Veje, E. (Univ. of Copenhagen). pp 135 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27150 REACTION SPECTROSCOPY POPULATING THREE QUASI-PARTICLE ROTATIONAL BANDS. Minor, Michael M.; Sheline, Raymond K. (Florida State Univ., Tallahassee). pp 136 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27151 INELASTIC SCATTERING OF FAST NEUTRONS FROM ^{197}Au. Barnard, E.; de Villiers, J. A. M.; Engelbrecht, C. A.; Reitmann, D. (South African Atomic Energy Board, Pretoria). pp 137 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27152 ENERGY LEVELS OF ODD MASS ISOTOPES OF Rh, Ag, AND In BY INELASTIC SCATTERING OF PROTONS. Thosar, B. V.; Sharma, R. P.; Prasad, K. G.; Pandharipande, V. R. (Tata Inst. of Fundamental Research, Bombay). pp 153 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27153 LEVEL SCHEMES OF ^{121}Sb AND ^{123}Sb THROUGH NEUTRON SCATTERING. Nath, N. (Banaras Hindu Univ., India); Gupta, A. K.; Siddiq, A. K. M. pp 154 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27154 COLLECTIVE LEVELS IN THE EVEN NEODYMIUM ISOTOPES. Burginyon, G. A.; Greenberg, J. S.; Casten, R. F.; Bromley, D. A. (Yale Univ., New Haven). pp 155 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27155 E2 TRANSITION PROBABILITIES IN THE OSMIUM ISOTOPES. Casten, R. F.; Greenberg, J. S.; Burginyon, G. A.; Bromley, D. A. (Yale Univ., New Haven). pp 156 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27156 THERMAL NEUTRON GAMMA-RAY SPECTRUM BY PLATINUM. Groshev, L. V.; Demidov, A. M.; Rakhimov, A. S. (Inst. of Atomic Energy, Moscow). pp 157 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27157 SINGLE-PARTICLE PROTON STATES IN ^{209}Bi EXCITED IN THE (^{3}He,d) REACTION. Igo, G. J.; Barnes, P. D.; Flynn, E. R.; Woods, R. (Los Alamos Scientific Lab., N. Mex.). pp 158 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27158 INVESTIGATION OF THE LEVEL STRUCTURE OF NIOBIUM AND TANTALUM BY THE (n,n') REACTION USING A TIME GATED Li-Ge SPECTROMETER. Beghian, L.; Clikeman, F.; Hofmann, F.; Mahoney, F.; Wilensky, S. (Massachusetts Inst. of Tech., Cambridge). pp 159 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27159 NUCLEAR STRUCTURE STUDIES BY MEANS OF (n,n'γ) REACTIONS. Mathur, S. C.; Buchanan, P. S.; Williams, G. H. (Texas Nuclear Corp., Austin). pp 160 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27160 LEVEL SYSTEMATICS OF EVEN–EVEN Te AND Xe ISOTOPES. Bergstroem, I.; Herrlander, C. J.; Kerek, A.; Luukko, A. (Research Inst. for Physics, Stockholm). pp 161 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27161 GAMMA-RAY SPECTRA FROM RESONANCE NEUTRON CAPTURE ON Cs AND Ba. Becvar, F.; Vrzal, J.; Liptak, L.; Urbanec, J. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 162 of Contributions, International Conference on Nuclear

Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27162 CONVERSION ELECTRONS FROM (α,xn) REACTIONS ON Sm ISOTOPES AND NUCLEAR STRUCTURES OF Gd NUCLEI. Ejiri, H.; Ishihara, M.; Sakai, M.; Katori, K.; Inamura, T. (Tokyo Univ.). pp 163 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27163 NUCLEAR SPECTROSCOPY FOLLOWING ^{40}Ar,xn REACTIONS. Stephens, F. S.; Ward, David; Newton, J. O. (Univ. of California, Berkeley). pp 164 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27164 ROTATIONAL BANDS IN ^{181}Re AND ^{183}Re. Hjorth, S. A.; Ryde, H.; Skanberg, B. (Research Inst. for Physics, Stockholm). pp 165 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27165 STUDY OF SOME NEUTRON-DEFICIENT DOUBLY EVEN NUCLEI OF Hg AND Pb BY (p,4nγ) AND (p,6nγ) REACTIONS. Ishihara, M.; Ejiri, H.; Gono, Y.; Sakai, M.; Katori, K. (Tokyo Univ.). pp 166 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

27166 TIME ANALYSIS OF REACTION γ RAYS AND ELECTROMAGNETIC PROPERTIES OF ^{210}Po LEVELS. Yamazaki, T.; Matthias, E.; Prussin, S. G.; Lederer, C. M.; Jaclevic, J.; Hollander, J. M. (Univ. of California, Berkeley). pp 167 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910

27167 THE DECAY OF ^{92}Tc AND ^{102}Rh. Konijn, J.; Lingeman, E. W. A.; Goudsmit, P. F. A. (Inst. for Nuclear Physics Research, Amsterdam. Univ., Freiburg i. B.). pp 170 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27168 ON LINE STUDY OF SHORT LIVED Rb AND Cs ISOTOPES. Amarel, I.; Bernas, R.; Foucher, R.; Jastrzebski, J.; Johnson, A.; Marques, J.; Teillac, J. (Institut de Physique Nucleaire, Orsay, France). pp 171 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27169 EXCITED STATES IN ^{100}Ru AND ^{102}Ru. Hisatake, K.; Kawakami, H.; Adachi, M.; Taketani, H. (Tokyo Inst. of Tech.). pp 172 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
See CONF-670910.

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27222 EXPERIMENTAL MEASUREMENTS OF VIBRATIONAL SPLITTING OF THE GIANT DIPOLE RESONANCE. Cannington, P. H.; Owen, D. G.; Stewart, R. J. J.; Muirhead, E. G.; Spicer, B. M. (Univ. of Melbourne). pp 379 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27226 REPEATED EXPERIMENT ON THE OBSERVATION OF THE WEAK INTERNUCLEON INTERACTION. Abov, Yu. G.; Kruptchitskii, P. A.; Bulgakov, M. I.; Ermakov, O. N.; Karpikhin, I. L. (Inst. for Theoretical and Experimental Physics, Moscow). pp 396 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27227 HYPERFINE STRUCTURE AND MAGNETIC MOMENT OF ^{110m}Ag AND SPIN OF ^{163}Tm. Schmelling, Stephen Gordon. Berkeley, Calif., Univ. of California, 1967. 84p.
Thesis.
The atomic-beam magnetic-resonance technique was used to measure the free-atom ground state hyperfine-structure separation $\Delta\nu$, the nuclear magnetic moment μ_I, and the hyperfine-structure anomaly $^{109}\Delta^{110m}$ of 260-day Ag^{110m} ($I = 6$). The magnetic moment μ_I was obtained independently of $\Delta\nu$ by observing a $\Delta F = \pm 1$ doublet at its field-independent point. The results are $\Delta\nu(Ag^{110m}) = +30313.756(4)$ MHz, $\mu_I(Ag^{110m})$ (uncorr) $= +3.587(4)$ nm, and $^{109}\Delta^{110m} = -2.47(12)\%$. A short experiment was also done to measure the nuclear spin of 108-min ^{163}Tm. The result of this experiment is $I = \frac{1}{2}$ for ^{163}Tm. (Disser. Abstr.)

27228 A STUDY OF ISOBARIC ANALOGUE RESONANCES IN THE LEAD REGION. Lenz, George Henry. New Brunswick, N. J., Rutgers–The State Univ., 1967. 153p.
Thesis.
Isobaric analogue states of the ground and low-lying states of ^{205}Pb, ^{207}Pb and ^{208}Pb were studied as compound-nucleus resonances in ^{205}Bi, ^{207}Bi and ^{208}Bi by bombarding isotopically enriched targets of ^{204}Pb, ^{206}Pb and ^{207}Pb with protons in the energy range 11.00 to 16.00 MeV. The resonance parameters were determined by fitting the elastic-scattering excitation functions with an optical model plus isolated resonance expression. The elastic scattering partial widths of the $\frac{9}{2}^+$ analogues of the odd lead isotopes and the elastic and inelastic decay partial widths of the analogue of the ground state of ^{209}Pb are compared with single-particle estimates determined from a realistic, diffuse-edged, nuclear well. The sensitivity of the single-particle estimates to the different well parameters is discussed. The off-resonance yields to the ($\frac{5}{2}^-$, 0.570 MeV) state of ^{207}Pb, the (2^+, 0.899 MeV) state of ^{204}Pb and the (2^+, 0.804 MeV) state of ^{206}Pb were determined to be principally due to Coulomb excitation. Destructive interference between the Coulomb excitation and resonance processes is observed in the yields to the (2^+, 0.899 MeV) state of ^{204}Pb and to the (2^+, 0.804 MeV) state of ^{206}Pb. Striking elastic and inelastic proton-scattering systematics are seen in the decay of the $\frac{9}{2}^+$ analogues of the odd lead isotopes, and the related 5^- and 4^- analogue states of ^{209}Pb. Coulomb-energy differences and the isotope shifts deduced from the $\frac{9}{2}^+$ analogues of the odd lead isotopes and the 5^- and 4^- analogues of ^{208}Pb are compared with the predictions of the uniform charge model. (Disser. Abstr.)

27229 DIRECTIONAL CORRELATION MEASUREMENTS IN ^{211}Bi. Carlson, George Arthur. Davis, Calif., Univ. of California, 1967. 145p.
Thesis.
Directional correlation measurements of the 427-405 keV and 702-405 keV gamma-ray cascades in ^{211}Bi were made. The measured spins were found to be $\frac{9}{2}$ for the 832-keV state and $\frac{9}{2}$ for the 1104-keV state. The transitions are M1 with an E2 mixing of 42% ± 3%, 17% ± 3%, and 8% ± 11% for the 405-, 427-, and 702-

keV transitions, respectively. In addition, the internal conversion coefficients of the 351- (Tl^{207}) and 405-keV lines in the spectrum were measured to be 0.167 ± 0.015 and 0.0796 ± 0.006, respectively. (Diss. Abstr.)

27230 SPECTROSCOPIC STUDY OF THE PROTON GROUND-STATE CONFIGURATIONS IN THE ZIRCONIUM ISOTOPES. Freedom, Barry Mason. Knoxville, Tenn., Univ. of Tennessee, 1967. 110p.

Thesis.

An investigation of the proton ground-state configurations in the even zirconium isotopes was undertaken using the (d,^{3}He) reaction. The effect of adding pairs of $2d_{\frac{5}{2}}$ neutrons on the $(2p_{\frac{1}{2}})^2 + (1g_{\frac{9}{2}})^2$ proton admixture known to exist in ^{90}Zr was studied as an indication of the relative strengths of the p-d and g-d proton-neutron interactions. Enriched targets of the zirconium isotopes (A = 90, 92, 94, 96) were bombarded using a 34.4-MeV deuteron beam from the Oak Ridge Isochronous Cyclotron. A ΔE-E Si surface barrier detector telescope was used to obtain ^{3}He angular distributions leading to states of less than 3.0-MeV excitation in the yttrium isotopes (A = 89, 91, 93, 95). The experimental angular distributions were compared with distorted-wave calculations using a local zero-range approximation and a finite-range approximation which included non-locality in the distorted waves. Optical parameters used in the calculations were obtained from 34.4-MeV deuteron elastic scattering from the zirconium isotopes and from 24.7-, 30.7-, and 41-MeV ^{3}He elastic scattering from ^{89}Y. It was found that all of the residual yttrium isotopes have $\frac{1}{2}^-$ ground states and that the observed spectra can be interpreted in terms of a simple shell-model picture which considers hole and particle configurations in the $1g_{\frac{9}{2}}$, $2p_{\frac{1}{2}}$, $2p_{\frac{3}{2}}$, and $1f_{\frac{5}{2}}$ proton shells and allowed couplings in the $2d_{\frac{5}{2}}$ neutron shell. Spectroscopic factors are presented for each observed transition. It was found that the $2d_{\frac{5}{2}}$ neutron shell has an effect on the proton configuration by changing the relative amounts of the $(2p_{\frac{1}{2}})^2$ and $(1g_{\frac{9}{2}})^2$ admixture in the zirconium ground states. The amount of the $(2p_{\frac{1}{2}})^2$ configuration is: 64 ± 4% for ^{90}Zr, 55 ± 4% for ^{92}Zr, 66 ± 4% for ^{94}Zr, and 86 ± 9% for ^{96}Zr. (Diss. Abstr.)

27231 IDENTIFICATION OF SINGLE-PARTICLE STATES IN THE FISSION TRANSITION NUCLEUS ^{235}U. Behkami, Aziz Nosrat. Evanston, Ill., Northwestern Univ., 1967. 123p.

Thesis.

Fission-fragment angular distributions were measured for the fission of ^{234}U induced by monoenergetic neutrons of energies 200, 300, 400, 500, 600, 700, 843, 998, and 1185 keV. Neutrons produced by the ^{7}Li(p,n) reaction, with an energy spread of about 15 keV, impinge on an isotopically pure ^{234}U target of 0.5 mg cm^{-2} thickness and $\frac{1}{8}$ inch diameter. The fission fragments are detected as a function of angle in 2π geometry with a polycarbonate resin detector. The overall angular resolution of the system including the neutron direction is about 7°. Corrections are made for angular resolution and the contribution of the lower energy neutron group which leaves ^{7}Be in its first excited state. The data were not corrected for fission induced by scattered neutrons because the calculated magnitude of this effect is small—between 2-4% depending on neutron energy. The shape of the fission-fragment angular distribution changes markedly with neutron energy and at some energies peaks at angles intermediate between 0 and 90°. Information on the spin, parity, energy, and barrier shape of transition states in ^{235}U* near the fission barrier is deduced by fitting these measured angular distributions and the cross-section measurements of Lamphere with a Hauser-Feshbach type calculation which includes, in addition to the fission channels, the open neutron and gamma-ray decay channels, taking into account level-width fluctuations. The fits to both types of data (fragment angular distribution and cross section) are statistically significant when judged by a χ^2 criterion. The following information is obtained from this analysis about the transition-state spectrum of ^{235}U*; there are at least 4 transition states of given K and Π (here K is the projection of total angular momentum along the symmetry axis of the deformed nucleus) contributing to the ^{234}U(n,f) cross section in the neutron energy region below 850 keV; and the most probable values of K and Π of these states are $\frac{1}{2}^+$, $\frac{3}{2}^-$, $\frac{1}{2}^-$, and $\frac{3}{2}^+$. (Diss. Abstr.)

27232 FIRST FORBIDDEN BETA DECAYS IN THE RARE EARTH REGION. Ellis, Yurdanur Akovali. College Park, Md., Univ. of Maryland, 1967. 166p.

Thesis.

The properties of nuclear states in the mass-144 region are studied in a systematic way by consideration of first-forbidden beta transitions. Specifically, the spectrum shapes of the ground state to ground state and the ground state to excited states forbidden beta transitions, and the beta-gamma correlations between the ground state to excited state beta transitions and the excited state to ground-state gamma transitions are investigated and calculated in detail on the basis of the shell model and of the collective model. In the formulation of the theory of forbidden beta transitions, the beta interaction in the form of V−1.2 A and the j-j coupling model and collective model are adopted. Particular attention is given to the states of, and the beta transitions between $^{144}_{58}$Ce, $^{144}_{59}$Pr, $^{144}_{60}$Nd nuclei. The comparisons of the theoretical calculations with the experimental results enable one to deduce information with regard to nuclear states which have been the subject of great confusion. The angular distribution of the beta particles from the ground state of oriented ^{144}Pr nucleus to the ^{144}Nd ground state is also computed for the purpose of comparison with contemplated experiments. (Diss. Abstr.)

27233 NUCLEAR SPIN AND HYPERFINE STRUCTURE MEASUREMENTS ON THE RADIOACTIVE ISOTOPES ^{116}In, ^{121}Sn, AND ^{88}Rb. Prior, Michael Herbert. Berkeley, Calif., Univ. of California, 1967. 100p.

Thesis.

The atomic-beam magnetic-resonance technique has been used to measure the nuclear spin of 66-min ^{116}In; the spin and hyperfine structure interaction constants, a and b, for 27-hr ^{121}Sn in the $^3P_1$ electronic state; and the a constant for 18-min ^{88}Rb(I = 2). Values of the nuclear moments are inferred from the measured interaction constants. The χ^2 of the least-squares computer fit to the observations is listed for the two possible signs of the interaction constants. The figures in parentheses represent the error in the last figure quoted. For μ_I the error is 1% to allow for effects of a possible hyperfine structure anomaly. For Q the error is 50% to allow for inaccuracies in the calculation (r^{-3}) and the effects of Sternheimer shielding. A relativistic calculation accounts for ≈$\frac{1}{3}$ of the a for ^{121}Sn and the remainder is attributed to the effects of configuration interaction. Second-order corrections to the hfs constants are shown to be negligible for ^{121}Sn. The nuclear quantities, except for Q, are in reasonable agreement with values calculated by using the shell model with an appropriate residual interaction, provided one takes the negative sign for the interaction constants. The quadrupole moment of ^{121}Sn may arise from polarization of the proton core. (Disser. Abstr.)

27234 BETA-GAMMA DIRECTIONAL CORRELATIONS IN ^{56}Mn AND ^{148}Pm. Greenberg, William Michael. Ann Arbor, Mich., Univ. of Michigan, 1967. 62p.

Thesis.

The theory of beta-decay predicts the correlation between the emission directions of a beta particle and a subsequent gamma-ray in the form of series in which nuclear matrix elements of the beta interaction Hamiltonian are unknown parameters. An experimental determination of the correlation for a specific isotope is important for the evaluation of these matrix elements which, in turn, provides a check on the accuracy of nuclear wave functions. For a 1^+ allowed beta-decay, only the first term of the series is usually considered to be finite. This predicts a correlation coefficient, A_2, of zero. However, the allowed 2.86-MeV beta transition in ^{56}Mn has an unusually large log-ft value (7.2) indicating that the first term in the series is reduced by some nuclear effect. If the higher-order terms of the series are not also reduced by the same effect, their contributions will be enhanced, and there will be a finite correlation. Measurements were made on this isotope giving a coefficient $A_2 = -0.0030 \pm 0.0011$. This shows that higher order terms do have an observable effect in this case and must be included in the theoretical description of this isotope. A check for systematic errors was made by comparing the result of the measurement on ^{56}Mn to that for a similar measurement on ^{131}I which gave $|A_2| < 0.0005$. For a first-forbidden beta transition, the first terms in the series for the correlation function are identically zero. The terms remaining predict a non-zero correlation coefficient which is a function of the beta-ray energy. If this functional dependence of the correlation coefficient is not dominated by the effects of the nuclear Coulomb field (the ξ-approximation), the measured correlation can provide information about the relative magnitudes of the contributing matrix elements. Directional correlation measurements were made on the first-forbidden 1.90-MeV beta transition in the decay of ^{148}Pm as a function of the beta energy from 1.0 to 1.7 MeV. The correlation coefficient varied from 0.041 ± 0.002 to 0.004 ± 0.017 in this range. The results of the measurement show that the energy dependence of the correlation does not follow the ξ-approximation. This can be the result of the mutual cancellation of matrix elements or of their reduction by nuclear selection rules. (Disser. Abstr.)

Nuclear Theory

Refer also to abstracts 26617, 26623, 26679, 26791–26795, 26799, 26802, 26805, 26806, 26813–26818, 26826, 26828, 26832, 26837–26839, 26843, 26851, 26853–26855, 26857, 26861–26864, 26879, 26880, 26883, 26885, 26889, 26895, 26896, 26905, 26907, 26915, 26917, 26922, 26923, 26926–26929, 26956, 26968, 26972,

26973, 26975, 26976, 26985, 27019, 27023, 27027, 27029, 27041, 27045–27047, 27070, 27072, 27080, 27082, 27092, 27094, 27095, 27110, 27114, 27132, 27135, 27136, 27138, 27139, 27148, 27159, 27177, 27178, 27209, 27217, 27225–27227, 27230, 27232, and 27234.

27235 (COO–1051-18) THE WORKINGMAN'S SHELL MODEL. Bertsch, George F. (Michigan State Univ., East Lansing). Jan. 1968. Contract AT(11-1)-1051. 39p. Dep. CFSTI.

Some of the techniques that are used in shell-model calculations are discussed. The basic formulas for calculating nuclear properties with correlation effects are derived, and the dependence of the physical matrix elements on correlations is discussed qualitatively. (D.C.W.)

27236 (NP–17348) EFECTO DE LAS CORRELACIONES ENTRE LAS FUERZAS NUCLEARES EN LA SECCION EFICAZ DE BREMSSTRAHLUNG DEL EFECTO FOTO-NUCLEAR USANDO REGLA DE SUMAS. (Effect of the Correlations Between Nuclear Forces in the Bremsstrahlung Cross Section of the Nuclear Photoeffect Using Sum Rules). Mercado Escutia, Gilberto (Instituto Politecnico Nacional, Mexico City, Escuela Superior de Fisica y Matematicas). Sept. 27, 1967. 49p. (In Spanish). Dep.

Thesis.

The sum rules are applied to the calculation of the correction to the bremsstrahlung cross section due to the velocity-dependent nuclear forces. The quasi deuteron model is used. This model is used because recent experiments on cross sections and the energy dependence of the photonuclear effect indicate that the dipolar contribution is the dominant contribution in the photonuclear process. The time-independent perturbation theory is used. For a calculation, a dependent potential in the linear moment equation was used. This produces the same dephasing as the hard core in the two-body problem. The parameters were taken from the effective path theory and the results were compared with the experimental data. (tr-auth)

27237 CORRECTIONS TO ELECTRON SCATTERING. Onley, D. S. (Ohio Univ., Athens). pp 372 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.

See CONF-670910.

27238 DOUBLE-NUCLEON EMISSION FOLLOWING THE ABSORPTION OF BOUND PIONS. Guy, Reed (Univ. of Virginia, Charlottesville); Eisenberg, J. M.; Letourneux, J. Nucl. Phys., A112: 689-96(1968).

The problem is considered in which a pion bound in a 1S or 2P atomic orbital is captured on a correlated pair of nucleons. The final-state mutual scattering of the nucleons in the emitted pair is included and proves to be of great importance. The absorption process is treated using a nonrelativistic pion-nucleon interaction, and several earlier approximative techniques are eliminated so as to extend the validity of the theory to small relative momenta for the pair. Numerical results are presented for ^{16}O, including angular correlations, energy distributions, and total absorption rates for the emission of neutron-neutron and proton-neutron pairs. (auth)

27239 NUCLEAR OCTUPOLE DEFORMATIONS. Vogel, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., A112: 583-93(1968).

The dependence of the nuclear potential energy on the parameters of the quadrupole and octupole deformation for nuclei in the $218 \leq A \leq 232$ region is investigated. The energy is calculated in the framework of the superfluid nuclear model. The minimum of the potential energy surface is obtained for $\beta_3 = 0$, i.e., there are no nuclei with non-zero equilibrium octupole deformation in the considered region. The dependence of the energy on the deformation differs essentially from the simple parabolic one, particularly a term of the $C_{13}\beta_2\beta_3^3$ type is present in $E(\beta_2,\beta_3)$ leading to an asymmetric energy surface and to an interaction between β-vibrations and octupole vibrations. (auth)

27240 PRESENT STATUS OF THE HALF-LIFE MEASURING EQUIPMENT AND TECHNIQUE AT STUDSVIK. Malmskog, S. G. (Aktiebolaget Atomenergi, Studsvik, Sweden). Ark. Fys., 35: 255-67(1968). (AE–301).

The equipment and techniques used at Studsvik for half life measurements of nuclear excited states using the delayed coincidence method are described. The experimental set up includes an electron-electron coincidence spectrometer and a fast pneumatic rabbit system attached to the high flux reactor R2 at Studsvik. Special efforts were made to adapt the system for work with short-life radioactive isotopes with decay times of the order of seconds. (auth) (Swed)

27241 A SHELL MODEL INTERPRETATION OF THE SPECTRA OF $2s_{\frac{1}{2}}-1d_{\frac{5}{2}}$ NUCLEI. Yang, Shan-te. Chin. J. Phys. (Peking) (Engl. Transl.), 21: 1928-42(Aug.–Dec. 1965).

Translated from Wu Li Hsueh Pao, 21: 1522-32(Aug. 1965).

The spectra of nuclei with A = 30, 31, 32, 37, and 38 were calculated according to Talmi's method, taking into account the mixing of states within the subshells $2s_{\frac{1}{2}}$ and $1d_{\frac{5}{2}}$. The calculated results are in good agreement with experimental data. (auth)

27242 $\Delta N = 2$ MIXING OF SINGLE-PARTICLE ORBITS IN DEFORMED ODD NUCLEI. Andersen, B. L. (Univ. of Copenhagen). Nucl. Phys., A112: 443-52(1968).

Recent experiments indicate a considerable mixing in deformed odd nuclei between certain single-particle states which originate from different major shells. It is shown that one must use a single-particle potential of Saxon-Woods shape in order to account for this mixing. (auth)

27243 NONLOCAL MODEL t-MATRIX IN A QUASI-THREE-BODY REACTION. Deutchman, P. A.; McCarthy, I. E. (Univ. of Oregon, Eugene). Nucl. Phys., A112: 399-416(1968).

The (p,2p) cross section is calculated using local and nonlocal p-p effective interactions in order to distinguish off-energy-shell effects between the interactions. The quasi-three-body assumption is used in which the effects of other channels are taken into account with a complex potential. The formalism used is the distorted-wave t-matrix approximation in the static limit. The distorted waves are approximated by fairly simple but realistic optical wave functions. The parameters involved in these approximate optical waves are determined using a local t-matrix and a good fit to the more complicated DWTA theory is obtained. The effects of these parameters on the (p,2p) cross sections are indicated. Then three values for the nonlocal range parameter R are chosen, one of which is zero and the parameters in all the t-matrices are adjusted to fit p-p scattering as closely as possible. The theoretical calculations fit the experimental p-p energy distribution at 90° in the center-of-mass system over a wide range of energies. Then the (p,2p) angular distributions are calculated using the nonlocal t-matrices, and the local and nonlocal (p,2p) cross sections are compared to experiment. It is seen that the off-energy-shell effects associated with each t-matrix are discernible, and a fairly good fit to experiment is obtained with R = 0.5 fm. (auth)

27244 PARTICLE TRANSFER REACTIONS AS PROBES OF PARTICLE UNSTABLE STATES. Levin, F. S. (Atomic Energy Research Establishment, Harwell, Eng.). Ann. Phys. (N. Y.), 46: 41-75(Jan. 1968).

Particle transfer reactions of the type (d,p), (^{3}He,n), etc., are proposed as a means for obtaining spectroscopic information on particle unstable states such as doorway states or isobaric analog states. Analysis in terms of a direct reaction model is made, and it is shown that the theory should be applied only to states whose width is no greater than approximately 100 keV. The continuum shell-model approach of Fano is used to construct the wave function of the decaying state, and both quasi-bound and continuum components are identified. The former gives rise to serial reactions, wherein the second emitted particle goes first into a bound orbit and then into a continuum orbit, while the latter component gives rise to parallel reactions in which both emitted particles go directly into continuum orbits. The treatment of the latter process is shown to encompass the analysis of Huby and Mines. Analyses of angular distributions for both singles and coincidence experiments are given, and it is concluded that measurement of the angular distribution of the "first" emitted particle, e.g., the proton in a (d,p) reaction, is the optimum means for obtaining spectroscopic information, since in this case the theoretical expressions reduce to an extremely simple form. (auth)

27245 STATISTICAL THEORY OF NUCLEAR REACTIONS AS A COMMUNICATION PROBLEM. II. CONSTANT AND ONE-LEVEL RESONATING AMPLITUDE. Bloch, C. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Nucl. Phys., A112: 273-95(1968).

The formalism developed in part I is applied to a simple statistical theory of nuclear reactions. The starting point is the Breit-Wigner expansion in which some terms are considered as describing a simple type of excitation, the parameters of which are to be determined from the experimental data, whereas the other terms are associated with compound nucleus levels and treated as a random noise. Two particular cases are treated in detail: the case of an energy independent amplitude, and that of a single isolated resonance. Expressions are derived for the most probable values of the parameters defining these amplitudes for a given set of observed cross sections, as well as for the statis-

tical uncertainty on these amplitudes introduced by the compound nucleus noise. (auth)

27246 STATISTICAL THEORY OF NUCLEAR REACTIONS AS A COMMUNICATION PROBLEM. 1. GENERAL METHOD. Bloch, C. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Nucl. Phys., A112: 257-72(1968).

It is suggested that the determination of the parameters of resonances in the presence of a fluctuating background of relatively narrow and dense compound nucleus resonances should be treated as a communication problem. The general formalism is described. Most probable values and probability distributions of the resonance parameters are derived, in the Gaussian approximation. The concept of information is introduced and its variational property is used as a justification of the Gaussian approximation. A first very elementary application is discussed. (auth)

27247 THE AKHIESER–POMERANCHUK-BLAIR MODEL ANALYSIS FOR ELASTIC SCATTERING OF DEUTERON. Sen Gupta, H. M. (Univ. of Dacca, Pakistan); Khan, A. H.; Rahman, M. Nucl. Sci. Appl., 3: 7-9(Oct. 1967).

Angular distributions of deuterons elastically scattered from Mg, Fe, Cu and Zn were analyzed using the Akhieser-Pomeranchuk-Blair model, and the best fit parameters of the analysis were obtained. (auth)

27248 SINGLE-PARTICLE GROUND-STATE MODEL OF ^{4}He. Gibson, B. F.; Goldberg, A.; Weiss, M. S. (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl Phys., A111: 321-30(1968). (UCRL-70722).

The ground state of the ^{4}He nucleus was studied using a single-particle phenomenological model. Wave functions are generated from a potential with parameters chosen to reproduce the correct neutron separation energy. The proton separation energy, electron scattering form factors, dipole photo-absorption cross sections for single-particle emission, and dipole sum rule are then calculated. The proton separation energy and dipole sum rule estimates are in satisfactory agreement with experiment. The form-factor calculation agrees with the data for $q^2 < 7$ fm^{-2}, but an infinitely repulsive core must be added to the central potential in order to reproduce the diffraction dip in the form-factor data at higher momentum transfers. The fit to the photo absorption cross-section data is not good, but residual interactions were ignored. (auth)

27249 TREATMENT OF THE HARD CORE IN THE TWO-NUCLEON POTENTIAL IN NUCLEAR-MATTER CALCULATIONS. Oestgaard, E. (Princeton Univ., N. J.). Phys. Rev., 168: 1139-44(Apr. 20, 1968).

Calculating the repulsive part of diagonal G-matrix elements in the Brueckner theory of nuclear matter, the method of Brueckner and Gammel for treating the hard core in the two-body potential when solving the Bethe-Goldstone equation was studied in detail. Their method is compared with a more exact method, and also with the reference-spectrum method of Bethe. For simplicity, the approximation of an effective mass and a reference spectrum for the energies of the intermediate states in all methods was used. The calculations are repeated for several values of the parameters defining the reference spectrum and for several values of the initial relative momentum of the two interacting nucleons. The hard-core treatment of Brueckner and Gammel turns out to be a very good approximation for calculations of G-matrix elements on the energy shell, but gets worse as one goes off the energy shell. (auth)

27250 TWO-NUCLEON PHASE-SHIFT-SET DISCRIMINATION BY MEANS OF THE BINARY OPTICAL POTENTIAL. Chalmers, Joseph S.; Saperstein, Alvin M. (Wayne State Univ., Detroit). Phys. Rev., 168: 1145-55(Apr. 20, 1968).

The scattering of nucleons from light nuclei at energies of 142, 210, and 310 MeV is calculated using the multiple-scattering optical potential obtained by retaining all terms which are binary or less in the two-nucleon amplitudes. The binary potential includes the impulse-approximation correction as well as the double-scattering correction. Nucleon-nucleus scattering observables are computed, using optical potentials calculated with some of the Yale and Livermore phase-parameter sets and the Fermi and Brueckner-Gammel nuclear-correlation functions. The observables are compared with data in an effort to ascertain the differences caused by changing N-N scattering phase parameters and/or nuclear-correlation functions and to see whether it is feasible to use such changes in attempts to pin down N-N and nuclear parameters. (auth)

27251 NUCLEAR SYMMETRY ENERGY. Brueckner, Keith A. (Univ. of California, San Diego, La Jolla); Coon, Sidney A.; Dabrowski, Janusz. Phys. Rev., 168: 1184-8(Apr. 20, 1968).

The energy of nuclear matter is determined for $\alpha = (N - Z)/(N + Z)$ in the range of 0 to 0.60. The results are applicable to superheavy nuclei and to problems of astrophysical interest. (auth)

27252 GENERALIZED HARTREE–FOCK APPROXIMATION FOR NUCLEON–NUCLEON SCATTERING. Celenza, Louis (Case Western Reserve Univ., Cleveland). Phys. Rev., 168: 1189-92(Apr. 20, 1968).

The generalized Hartree-Fock approximation is extended to nucleon-one-level nucleus scattering. The problems involved with the Pauli principle are in part taken into account. The effective scattering potential is of course still real. The virtue of the method is that it yields a unified approach to both the scattering and structure problems. (auth)

27253 PRODUCTION OF HEAVY SPALLATION HYPERNUCLEI BY 800-MeV/c K^- MESONS. Lou, A.; Goodhead, D. T. (Univ. of California, Los Angeles). Phys. Rev., 168: 1214-24 (Apr. 20, 1968).

The production of spallation hypernuclei is simulated by a Monte Carlo calculation. The results obtained from the present calculation are compared with those obtained experimentally from the interactions of 800-MeV/c K^- mesons with heavy nuclei (Ag or Br) in both K2 and K5 nuclear emulsions. The cascade stage was simulated in a very rough approximation; the evaporation stage was calculated in detail. The production features predicted from this calculation are in good agreement with those observed experimentally, except for the range distribution. The observed discrepancy is considered to be due to the rough approximation in the present computation in simulating the cascade stage. However, the present calculation indicates that the spallation model can still be regarded as a reasonable approximation to the production mechanism of heavy hypernuclei. (auth)

27254 ISOBARIC ANALOGUE RESONANCES IN NUCLEI OF CLOSED NEUTRON SHELLS. Beregi, P. (Central Research Inst. for Physics, Budapest); Lovas, I. Nucl. Phys., A111: 289-314(1968).

The scattering amplitude of elastic proton scattering is investigated in the energy range of the isobaric analog resonances. The scattering amplitude is expressed as $T = T^{opt} + T^{res}$, where the background term T^{opt} is calculated by means of the standard optical model, and the resonance term is derived by the Feshbach projection-operator method. The "ideal" isobaric analog states are introduced by applying the step-down isospin operator T_- on the wave functions of the low-lying states of the target + neutron system. Then the "target ground state + proton" component of the ideal IAS is projected out. Such a doorway type state, the so-called "projected" IAS, is assumed to play the role of the intermediate state of the scattering process. The method is applied to the calculation of the cross section and polarization of elastic proton scattering on ^{138}Ba, ^{140}Ce, and ^{142}Nd. The low-lying states of the target are calculated in the framework of the quasi-particle random phase approximation, and the wave functions for the target + neutron system are obtained by diagonalizing the residual interaction in the quasi-boson + single-neutron basis. (auth)

27255 ON THE MANY-BODY THEORY OF NUCLEAR REACTIONS. Dietrich, Klaus; Hara, Kenji (Univ., Heidelberg). Nucl. Phys., A111: 392-416(1968).

The shell-model theory of nuclear reactions is generalized to incorporate a simple description of ground-state correlations and the excitation of collective states. The theory is based on the "random phase approximation," which is generalized to the case of a finite shell-model potential. The S-matrix is explicitly calculated for the case of nucleon scattering from an even-mass and odd-mass target, assuming for simplicity a separable particle-hole interaction. (auth)

27256 ANGULAR DISTRIBUTION OF NEUTRONS IN MUON CAPTURE. Zlatarov, V. G. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 10-17(Nov.-Dec. 1967). (In Russian).

A formula was derived for the neutron angular distribution in the capture of polarized μ^- mesons from the K-orbit by nuclei with filled proton subshells. The spin-orbit interaction of the neutrons with the nucleus was taken into account in the Hamiltonian, as were velocity terms. The nuclear state functions were described by a shell model with j-j coupling. The asymmetry coefficient obtained for the angular distribution was not factored; therefore, the upper maximum of its absolute value was not limited by factorization. (tr-auth)

27257 VERTEX PARTS AND OVERLAP INTEGRALS IN THE THEORY OF DIRECT NUCLEAR REACTIONS. Al-Beidori, M. M.; Blokhintsev, L. D.; Dolinskii, E. I.; Turovtsev, V. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 6, 3-9(Nov.-Dec. 1967). (In Russian).

Studies are made of the general properties of the vertex part

(or decay amplitudes of the nucleus A into two nuclei B and a: $A \rightarrow B + a$) in nonrelativistic theory. A relation is found between the vertex parts and overlap integrals in the intrinsic wave functions of the nuclei A, B, and a that appear in the ordinary formulation of the theory of direct nuclear reactions. (tr-auth)

27258 EXPERIMENTAL METHODS IN SEARCH FOR LOW-INTENSITY POSITRON RADIATIONS. Varga, Dezso. ATOMKI (At. Kut. Intez.) Kozlem., 9: 361-74(Dec. 1967). (In Hungarian).

A survey is given on the results of a search for low-intensity ($<10^{-4}$ per decay) positron radiations in radioactive decays and on the applied experimental methods, pointing out the importance of such investigations in nuclear spectroscopy. (auth)

27259 EFFECTIVE MASS IN NUCLEI. Bertsch, G. F.; Kuo, T. T. S. (Princeton Univ., N. J.). Contract AT(30-1)-937. Nucl. Phys., A112: 204-8(1968). (PUC-937-289).

Core polarization renormalizes the single-particle strength by ≈25% in intermediate and heavy nuclei. This produces a corresponding increase in the effective mass of particles near the Fermi surface. (auth)

27260 QUANTAL EFFECTS IN MULTIPLE COULOMB EXCITATION. Smilansky, U. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A112: 185-94(1968).

Quantal effects in multiple Coulomb excitation are discussed mainly in relation to their influence on the quadrupole moments of excited states which are deduced from multiple excitation experiments. The effects are calculated by using the coupled-channel formalism. Some examples of the results are discussed in more detail, and it is shown that for certain experimental conditions, the quantal effects might be of importance. (auth)

27261 AUTOIONIZATION IN β^- DECAY. Erman, Peter; Sigfridsson, Bertil; Carlson, Thomas A.; Fransson, Kjell (Research Inst. for Physics, Stockholm. Research Inst. of National Defense, Stockholm). Nucl. Phys., A112: 117-36(1968).

Autoionization in the K shell of an atom undergoing β^- decay was studied from experimental and theoretical points of view. In the experiments, the subsequent K x rays were measured in coincidence with various segments of the β^- spectra of ^{169}Er and ^{210}Bi, and the energy dependence of the autoionization was established. From this measured energy dependence and the simultaneously measured total K autoionization probabilities, it has been shown that electron shake-off is the predominant mechanism, and if there is a contribution from direct collisions, this could only form a minor part. A theoretical discussion of electron shake-off is given in terms of both a one-step and a two-step process, and the importance of the neutrino is discussed. The total K autoionization probabilities were found to be $\overline{P}_K = 2.4 \pm 0.4 \times 10^{-4}$ (^{169}Er) and $\overline{P}_K = 2.0 \pm 0.4 \times 10^{-4}$ (^{210}Bi), which are in agreement with recent electron shake-off calculations based on relativistic Hartree-Fock–Slater wave functions. (auth)

27262 ENERGY DEPENDENCE OF PHENOMENOLOGICAL OPTICAL-MODEL POTENTIALS. Lipperheide, R.; Schmidt, A. K. Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A112: 65-75(1968).

The energy dependence of the integrated phenomenological optical-model potentials for proton scattering of ^{40}Ca, ^{12}C and ^{58}Ni is fitted by a dispersion relation, taking account of nonlocality effects. The optical-model potential is written as a sum of a hermitian nonlocal Hartree-Fock type potential and a local energy-dependent complex term. Reasonable values for the parameters of the Hartree-Fock type potential are found. (auth)

27263 TWO-NUCLEON TRANSFER REACTIONS WITH VIBRATIONAL NUCLEI AND TWO- AND FOUR-QUASIPARTICLE TAMM–DANCOFF MICROSCOPIC THEORIES OF VIBRATIONAL STATES. Gyarmati, B.; Sawicki, J. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys., A111: 609-22(1968).

The spectroscopic factors of the two-nucleon transfer reaction amplitudes are calculated with the microscopic theories of the quasi-particle Tamm-Dancoff (QTD) and "second" Tamm-Dancoff (QSTD) methods. The latter theory describes vibrational states in terms of zero-, two- and four-quasi-particle excitations. The the ory is applied to study (p,t) and (t,p) reactions in even tin isotopes. The QTD and QSTD eigenvectors correspond to two different residual interaction potentials. The four-quasi-particle correlations cause quite a considerable reduction of the spectroscopic factors relative to those of the QTD theory. (auth)

27264 POLARIZATION OF PROTONS ELASTICALLY SCATTERED BY COMPLEX NUCLEI. Gubkin, I. A. (Leningrad State Univ.). Nucl. Phys., A111: 605-8(1968).

The formula describing the polarization of protons elastically scattered from spin-zero target nuclei is derived in the semiclassical approximation. The formula thus obtained agrees well with experimental data. (auth)

27265 THE PULSE APPROXIMATION IN MULTIPLE COULOMB EXCITATION. Douglas, A. C. (Atomic Weapons Research Establishment, Aldermaston, Eng.); Taylor, C. H. Nucl. Phys., A111: 597-604(1968).

The accuracy of the pulse approximation in multiple Coulomb excitation is studied by comparing the excitation probabilities calculated in this approximation with those obtained by a numerical solution of the exact coupled equations for the case of heavy ions backscattered from deformed doubly even nuclei. (auth)

27266 ELECTRIC LEVELS AND TRANSITION RATES IN ^{12}C, ^{16}O, AND ^{28}Si. Catara, F.; Di Toro, M.; Stazi, O. (Univ., Catania, Italy). Nucl. Phys., A111: 577-96(1968).

The electric levels of ^{12}C, ^{16}O, and ^{28}Si nuclei and the corresponding g.s. transition rates are calculated in TD and ETD approximations. The results are compared with other TD or RPA calculations and with experiment. The differences between the TD and ETD eigenvalues come out to be quite important (≈ 2 MeV) for some even-parity levels. The variations in the e.m. transition probabilities are, in general, in the good direction with respect to the available experimental data. Some possible sources of the sometimes dramatic discrepancies between theory and experiment are discussed. (auth)

27267 EXACT AND APPROXIMATE ANGULAR MOMENTUM PROJECTION FOR LIGHT NUCLEI. Lamme, H. A.; Boeker, E. (Vrije Univ., Amsterdam). Nucl. Phys., A111: 492-512(1968).

Angular momentum projection is carried out in an exact way on Slater determinant wave functions for the axially symmetric nuclei ^{8}Be and ^{12}C and the asymmetric 4p-4h state in ^{16}O. In the latter case, it is shown that the projected energies and the $B(E2, 2^+ \rightarrow 0^+)$ value for the K = 0 band in the 4p-4h state are consistent with the Brown and Green model. An approximate method for the calculation of the projected energies is given for the axially symmetric cases. Using this method, one obtains the binding energies of the projected states easily and with good accuracy. The excitation energies are less well reproduced. (auth)

27268 STRIPPING FORM FACTORS AND PSEUDOPOTENTIALS. Prakash, A. (Yale Univ., New Haven). Contract AT(30-1)-1807. Phys. Rev. Lett., 20: 864-7(Apr. 15, 1968). (YALE-1807-50).

It was previously found that the structure-stripping method (Nucl. Phys., 72: 337 and 641(1965)) of solving the form-factor equation for the reaction ^{58}Ni(p,d)^{57}Ni gave $p_{\frac{3}{2}}$ and $p_{\frac{1}{2}}$ form factors which were almost indentical to the corresponding form factors from the well-depth prescription, while the $f_{\frac{5}{2}}$ form factor differed appreciably from the prediction of the well-depth prescription. The $f_{\frac{5}{2}}$ form factor from the structure-stripping calculation gave a better fit to the experimental data than the conventional data. An attempt to determine why the conventional well-depth prescription gives accurate form factors in many cases but not in other cases is outlined. The pseudopotential that appears in the well-depth formulation of the form-factor equation was calculated for the $p_{\frac{3}{2}}$, $f_{\frac{5}{2}}$, and $p_{\frac{1}{2}}$ form factors for the ^{58}Ni(p,d)^{57}Ni transitions to the ground ($\frac{3}{2}^-$), 0.78-MeV ($\frac{5}{2}^-$), and 1.08-MeV ($\frac{1}{2}^-$) states of ^{57}Ni, respectively. (D.C.W.)

27269 MULTIPLE SCATTERING OF α PARTICLES. Lassen, N. O.; Ohrt, Arne (Niels Bohr Inst., Copenhagen). Fyz. Tidsskr., 65: No. 3, 65-96(1967). (In Danish).

A simplified theory of multiple scattering is presented. G. Molière's treatment of small-angle scattering is explained. Scattering experiments made at the Niels Bohr Institute in Copenhagen with 20-MeV α particles and ThC + C′ α particles (8 MeV and 6 MeV) are described, and a remark is added on small-angle scattering in crystals and the agreement with the so-called "string" effect. (DENMARK)

27270 CORE POLARIZATION AND THE SCATTERING OF 155-MeV PROTONS. Love, W. G. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Lett., 26B: 271-3 (Feb. 5, 1968). (ORNL-P-3619).

Core polarization effects are shown still to be important for the inelastic scattering of 155-MeV protons when a simple shell-model description of the nuclear states is used. (auth)

27271 EFFECT OF NUCLEON CONTINUA ON INELASTIC ELECTRON SCATTERING FORM FACTORS. Antony-Spies, P. (Univ., Frankfurt am Main); Donner, W.; Wahsweiler, H. G.; Greiner, W. Phys. Lett., 26B: 268-70(Feb. 5, 1968).

It is shown that the diffraction zeroes in the Born approximation result for the differential electron scattering cross section are replaced by finite minima if the continuum structure of the excited nuclear states is treated properly. (auth)

27272 COMMENT ON SPECTROSCOPIC FACTORS. Butler, S. T.; Hewitt, R. G. L.; Truelove, J. S. (Univ. of Sydney). Phys. Lett., 26B: 267(Feb. 5, 1968).

It is shown that a theorem analogous to that of Jost and Kohn applies to the complex nuclear problem. In principle, knowledge of the continuum wavefunctions for neutron scattering from a nucleus for a particular l-value determines the spectroscopic factors for discrete states of this l-value, in terms of the assumed number of such states. (auth)

27273 ANALYSIS OF (d,p) REACTIONS. Butler, S. T.; Hewitt, R. G. L.; Truelove, J. S. (Univ. of Sydney). Phys. Lett., 26B: 264-6(Feb. 5, 1968).

An extension of the method of Butler et al. (Ann. Phys., 43: 282 (1967)) of (d,p) analysis is noted. The fact that there must be a correlation between the spectroscopic factors for discrete states and continuum matrix elements is made clear. Application of this study to the $^{40}Ca(d,p)^{41}Ca$ reaction confirms a ground-state spectroscopic factor in the vicinity of 0.6. It appears clear that there must be an $f_{\frac{1}{2}}$ excited state in the ^{41}Ca spectrum to take up the remaining single-particle strength. It is possible that this could be a sharp $f_{\frac{1}{2}}$ resonance in the low-energy continuum (auth)

27274 COMPARISON BETWEEN THE VALUES OF THE NUCLEAR LEVEL DENSITY PARAMETER AT ~8- AND ~20-MeV EXCITATION ENERGIES. Facchini, U.; Marcazzan, M. G.; Milazzo-Colli, L.; Saetta-Menichella, E. (CISE, Milan. Univ., Milan). Phys. Lett., 26B: 278-80(Feb. 5, 1968).

Values of the level density parameter a are obtained at 8-MeV excitation energy from slow neutron and proton resonances and at 20-MeV excitation energy by the values of the average nuclear level width Γ. Both groups of a values are in good agreement with each other. (auth)

27275 GROUND-STATE PROPERTIES OF NUCLEAR MATTER IN THE Λ_{11} APPROXIMATION. Wegmann, G.; Weigel, M. (Univ., Frankfurt am Main). Phys. Lett., 26B: 245-7(Feb. 5, 1968).

The ground-state properties of nuclear matter are calculated in the Λ_{11}-approximation proposed by Puff (Phys. Rev., 149: 778 (1966)). Using a simple nucleon-nucleon interaction of the Yamaguchi type, the high momentum tail of the momentum distribution function is estimated. Its effect on the equilibrium properties of nuclear matter is found to be small. (auth)

27276 STATIC QUADRUPOLE MOMENTS OF PROJECTED DEFORMED STATES. Broglia, R. A. (Univ. of Copenhagen); Soerensen, B.; Udagawa, T. Phys. Lett., 26B: 250-1(Feb. 5, 1968).

It is suggested that the gross behavior of the static quadrupole moments of the first excited 2^+ states in both vibrational and rotational regions can be derived from an axially symmetric deformation of the nucleus. When this deformation is small, one can expect nonadiabatic effects. The nonadiabatic effects were partly included by use of projected wavefunctions. The actual calculation was performed for ^{152}Sm; but, by varying the deformation parameter, it was possible to reproduce the systematic trend of the observed ratios of the static to transition quadrupole matrix elements. (auth)

27277 SURFACE PHENOMENA IN FERMI LIQUIDS. Feibelman, P. J. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Phys. Lett., 26B: 601-3(Apr. 15, 1968).

The surface motion of a finite Fermi fluid is described quite generally. Waves are found to propagate only when there are gaps in the particle-hole spectrum. The effects of surface waves in the nuclear optical potential are studied. (auth)

27278 EVIDENCE FOR A SYMMETRY TERM IN THE OPTICAL POTENTIAL FOR NEUTRONS. Holmqvist, B.; Wiedling, T. (Aktiebolaget Atomenergi, Studsvik, Sweden). Phys. Lett., 26B: 620-2(Apr. 15, 1968).

The analyses of 6-, 7-, and 8-MeV neutron differential elastic scattering of 13 elements ranging from Al to Bi have revealed evidence for a symmetry term in the real optical neutron potential. It is also shown that the real-potential depth is a decreasing function of the mass number at each energy. (auth)

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27281 N–N ONE-BOSON EXCHANGE POTENTIALS FOR NUCLEAR PHYSICS. Green, A. E. S.; Sawada, T. (Univ. of Florida, Gainesville). pp 5 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27284 REPULSIVE CORE OF NUCLEAR FORCES. Sato, M.; (Hokkaido Univ., Sapporo); Tamagaki, R.; Wada, M. pp 8 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27288 PROTON–PROTON BREMSSTRAHLUNG AT 52.3 MeV. Sanada, J. (Tokyo Univ.); Yamanouchi, M.; Tagishi, Y.; (and others). pp 12 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27392 ELASTIC AND INELASTIC NUCLEAR FORM FACTORS FOR PHOTOPAIR PRODUCTION. Tsai, Y. (Stanford Univ., Calif.). pp 417 of Contributions, International Conference on Nuclear Structure, September 7–13, 1967, Tokyo, Japan. Tokyo, Tokyo Univ., 1967.
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27393 NUCLEAR PHYSICS. Salvy, M. pp 1-141 of Genie Atomique. Tome I. Cours Fondamental. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1967. (In French).

The principles of nuclear physics that are of interest in connection with reactors are reviewed. The general properties of nuclei, the general laws of radioactivity and the interaction of radiation with matter, neutron interactions with nuclei, and the phenomenon of fission are discussed. (D.C.W.)

27394 SYSTEMATICS OF MUON CAPTURE IN A NUCLEAR SHELL MODEL. Bogan, Alexander Jr. Cleveland, Case Inst. of Tech., 1967. 143p.

Thesis.

The implications of the universal Fermi interaction hypothesis (UFI) with bare V-A coupling and conserved vector current to the total rate for muon capture in nuclei are reviewed. The total capture rates for many nuclei are calculated in a closure approximation using a nuclear shell model. It is found that restricting the model to stable nuclei greatly reduces the scatter about a straight line on a Primakoff plot. The values predicted for the weak interaction coupling constants assuming reasonable values for the average momentum of the emitted neutrinos are about two thirds of the UFI values or, if one accepts the UFI coupling constants, the necessary neutrino momentum is found to be about 10% less than one would expect. The sources of error in this model are discussed, and it is concluded that the inability to accurately predict the total capture rate stems from the difficulty in choosing an appropriate average neutrino momentum as required by the closure approximation. (Diss. Abstr.)

27395 DIE RAEUMLICHE QUANTENMECHANISCHE AXIAL- UND SCHALENSTRUKTUR DER ATOMKERNE. (Spatial Quantum Mechanical Axial and Shell Structure of the Atomic Nucleus). Weckering, Rudolf. Stereophysik. Band VI. Luxemburg, Buchdruckerei Camille Hermann, 1967. 338p.

A new theory is presented of the spatial quantum mechanical axial and shell structure of the nucleus. No mathematical derivation of the theory is given as it is written for both the layman and the theoretician. The factors considered in the derivation of the theory are the universal structure of the nodic wave field; the manner of occupation of the shell and nucleus nodic wave field; internal, external, and total spin of individual nucleons; manner of construction of the atomic particles in the shell and nucleus nodic field; basis for the formulation of the spatial structure of proton and neutron frame; formulation of the new energy level system and the spatial axial and shell structure of the nucleus; azimuthal parity of the nucleus in the ground state; origin and nature of nuclear binding forces; energy level symbol and spatial structure of the nucleus in its ground state; the electrical quadrupole moment of the nucleus; origin and nature of the shell and nuclear energy quanta; spatial shell frame of the excited atom; the excitation structures of the nucleus; origin of gamma quanta; origin of the visible breakdown of the symmetry parity laws in the atomic and subatomic region; and nuclear dimensions and density. (J.S.R.)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 25441, 25463, 25691, 26036, and 27514.

27396 (AI-AEC-12638) AEC UNCLASSIFIED PROGRAMS. Quarterly Technical Progress Report, October–December 1967. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. 209p. Dep. CFSTI.

NEUTRON CROSS SECTIONS—SCORE evaluation system for, description of
THORIUM ISOTOPES Th-232—neutron cross section for, use of optical model for evaluation of
COPPER ISOTOPES Cu-63—neutron total cross sections for, evaluation of; resonance parameters for, negative energy; neutron cross section for, evaluation of radiative capture
COPPER—neutron total cross sections for, evaluation of; solubility in high purity liquid sodium, effects of temperature on; defects in, effects of temperature and radiation on dislocation pinning
COPPER ISOTOPES Cu-65—neutron total cross sections for, evaluation of; resonance parameters for, negative energy; neutron cross section for, evaluation of radiative capture
URANIUM ISOTOPES U-238—neutron cross section for, use of optical model for evaluation of; reactivity worth measurements in fast spectrum reactor
REACTORS, FAST—core for, temperature coefficient of thorium metal
THORIUM—reactivity worth measurements in fast spectrum reactor
PLUTONIUM—Doppler effect of, effects of isotopic composition on
REACTIVITY—worth measurements of thorium and uranium-238 in fast spectrum reactor; temperature coefficient of, effects of plutonium isotopic content on; worth measurement of uranium-235, effects of mass on
CESIUM—volatility of, effects of liquid sodium flow rate on relative
SODIUM OXIDES—aerosols of, characterization of
AEROSOLS—production in sodium-cooled reactors of sodium oxide
SODIUM—flow rate of liquid, effects on relative volatility of cesium of; adsorption-trapping experiments on liquid; radioactivity removal from liquid, effects of additional cesium on efficiency of cold trap for; temperature of bulk liquid, burning and release rate dependence of; liquid superheat tests on, summary of results of; solvent properties of high purity liquid, effects of temperature on; analyses using spark source mass spectrometers
REACTORS, LIQUID METAL-COOLED—sodium fires in, energy distribution in simulation of; pressure loss accident calculations for sodium, comparison of results from BURP- and TRANSFUGUE IIa-code for; sodium coolant for, oxygen meter for impurity determination in; fuel elements for, stress rupture tests for cladding for
REACTOR FUEL ELEMENTS—cladding for sodium-cooled; cladding for, determination of mechanical properties in dynamic sodium atmosphere of; irradiation swelling of tungsten-dispersed uranium carbide; temperature profiles of irradiated tungsten-dispersed uranium carbide
HEATERS—operations testing of high-flux, lifetime determination by
REACTOR CONTROL ELEMENTS—cladding for, determination of mechanical properties in dynamic sodium atmosphere of
INCOLOY 800—tensile properties of
URANIUM CARBIDES—UC–W, fuel dispersion of, irradiation swelling tests on
TUNGSTEN ALLOYS AND SYSTEMS—UC–W, fuel dispersion of, irradiation swelling tests on
STAINLESS STEELS—stress-rupture testing in sodium of Type 304; strain rate behavior of Type 304 and Type 316; impact strength of Type 304, use of Charpy V-notch specimens for; tensile properties of Type 316; failure modes of Type 316 specimens of
IRON—defects in fcc γ-phase, energy characteristics of vacancy cluster; solubility in high purity liquid sodium, effects of temperature on
NICKEL—solubility in high purity liquid sodium, effects of temperature on; determination in high purity liquid sodium, rise of atomic-absorption and spectrophotometry for
MOLYBDENUM—solubility in high purity liquid sodium, effects of temperature on
MASS SPECTROMETERS—sodium analyses using spark source
HALLAM POWER REACTOR—retirement of, summary of efforts toward
SODIUM REACTOR EXPERIMENT—retirement of, summary of efforts toward
BISMUTH CHLORIDES—conductivity of, results of calculation of molar
MERCURY CHLORIDES—conductivity of, results of calculation of molar
COPPER CHLORIDES—electric conductivity of 9.9 and 13.6 mole % $CuCl_2$, measurement of
BISMUTH HALIDES—electric conductivity at high temperatures, measurement of
ALUMINUM CHLORIDES—electric conductivity of pure, measurement from 192°C–600°C of
MERCURY IODIDES—thermoelectric properties of solutions of mercury in, measurement of
BUTANE, 2,2-DIMETHYL-—photolysis at 1470Å, measurement of products of
FREE RADICALS—production by photolysis and radiolysis of pentane
ALUMINUM—resistivity of, effects of radiation near room temperature on recovery of
SEMICONDUCTORS—conductivity and Hall effect measurements in CaAs, effects of temperature and irradiation on
NUCLEIC ACID, DEOXYRIBO-—reactions with hydrogen, ESR spectral analysis of
NUCLEO PROTEINS—reactions with hydrogen, ESR spectral analysis of
NUCLEOTIDES—reactions with hydrogen, ESR spectral analysis of
PENTANE—photolysis at 1470Å of, radical yields of; radiolysis at 1470Å of, radical yields of
HYDROGEN—reactions with DNA, ESR spectral analysis of; reactions with nucleoproteins, ESR spectral analysis of; reactions with nucleotides, ESR spectral analysis of (M.L.S.)

27397 (ANL-7375, pp 135-59) REACTOR SAFETY. (Argonne National Lab., Ill.).

REACTORS, WATER-COOLED—coolant loss accidents in, CHEMLOC-II code calculations of metal-water reaction, core heating, and core motion following; excursion accidents in, metal-water reaction, fuel heating, and fuel failure during, (E/T)

REACTOR FUEL ELEMENTS—meltdown of Zircaloy-clad uranium oxide (UO_2)-core, in simulated water-coolant loss accidents; cooldown of Zircaloy-clad uranium oxide (UO_2)-core, effects of emergency coolant spray on; meltdown of Zircaloy-clad uranium oxide (UO_2)-core, in TREAT simulated excursion accidents; meltdown and dispersal of mixed-oxide, in sodium-cooled reactors, (E/T)

SPRAY COOLING SYSTEMS—cooldown effects on Zircaloy-clad uranium oxide (UO_2)-core fuel elements in simulated coolant loss accidents

REACTOR FUELS—dispersal in sodium and water coolants, heat transfer and pressure generation by high temperature, (E/T)

REACTORS, FAST—fuel element meltdown and dispersal effects in sodium-cooled, (E/T)

URANIUM OXIDES UO_2—heat capacity of liquid, (E); CeO_2–UO_2, cerium migration in thermal-gradient heated pellets of, (E)

PLUTONIUM—migration in mixed-oxide reactor fuels, (E)

CERIUM—migration in thermal-gradient heated cerium oxide (CeO_2)–uranium oxide (UO_2) pellets, (E) (H.D.R.)

27398 (BAW-1280-50) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Quarterly Progress Report, October–December 1967. (Babcock and Wilcox Co., Barberton, Ohio. Boiler Div.). Apr. 5, 1968. Contract AT(11-1)-1280. 11p. Dep. CFSTI.

An evaluation of several alternate ways to redesign the Prototype Steam Generator to eliminate stainless steel pressure parts is being made. Recommendations will be made to the Commission Fabrication of the Prototype is held up. A draft of the Interim Report containing design criteria, steam generator preliminary cost trend curves, and preliminary specifications has been submitted to the Commission for approval. (auth)

27399 (BMI-1835) AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT. Quarterly Progress

Report, January–March 1968. Morrison, David L.; Carbiener, Wayne A.; Ritzman, Robert L.; Blutreich, Joachim N.; Clark, William E.; Denning, Richard S.; Gieseke, James A.; Wooton, Roger O. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1968. Contract W-7405-eng-92. 31p. Dep. CFSTI.

The study is restricted to pressurized-water and boiling-water reactors, in which the maximum credible accident is considered to be a loss-of-coolant situation. Progress is reported under two broad topics, thermal and hydraulic considerations and fission-product behavior. Thermal and hydraulic considerations include: loss-of-coolant heat transfer and thermodynamics, and emergency cooling of the core. Fission-product behavior includes: the generation and release of fission products, and fission-product transport deposition. (auth)

27400 (BNWL-326(Rev.)) POWER REACTOR DESIGNS. An Annotated Bibliography. Appleby, E. R. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1968. Contract AT(45-1)-1830. 376p. Dep. CFSTI.

Revisions and updated information to the original bibliography on power reactors are included. This includes both foreign and domestic reactors. (M.L.S.)

27401 (BNWL-713) STEAM-COOLED FAST BREEDER POWER REACTORS PARAMETRIC DESIGN STUDIES. Fox, J. C.; Aase, D. T.; Wise, K. R.; Altschuler, S. J.; Busselman, G. J.; Holeman, R. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 83p. Dep. CFSTI.

Parametric studies are included on the effects on breeding ratio, doubling time, and fuel cycle cost of the following design parameters: steam conditions, turbine inlet pressure and temperature; core design, volume, and shape. The sensitivity of reactor performance to parameters, varied over certain ranges to reflect changes in design philosophy, are also examined. Parameters included: steam pressure of 1000 to 3000 psi; steam temperature of 900 to 1100°F; core volume of 5000 to 10,000 liters; and height to diameter ratio of 0.2 to 0.6. (auth)

27402 (BNWL-717) BINDING EFFECTS ON REACTIVITY CHANGE FOR TRANSITIONS FROM SOLID TO LIQUID PHASE IN A FAST REACTOR SYSTEM. Schenter, R. E.; Gibbs, A. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 22p. Dep. CFSTI.

The change in reactivity due to changes in the effective capture cross section of ^{238}U bound in a UO_2 lattice for transitions from solid to liquid phase is studied for a typical fast reactor system. Calculations indicate that this change in reactivity from the Doppler effect due to melting of UO_2 is negligible (less than 0.55 per cent). It is assumed that at the high melting temperature and for a fast reactor flux, the binding effects can be well described in terms of a free gas model with an effective temperature. The "weak binding" or "short compound nucleus lifetime" approximation is carefully investigated. (auth)

27403 (CONF-680204-2) WASTE HEAT RECOVERY. Mowery, John C.; Caldwell, Calvin G.; Eby, Udell (Vitro/Hanford Engineering Services, Richland, Wash.). [1968]. 9p. Dep. CFSTI.

From American Institute of Chemical Engineers Society Meeting, Corvallis, Ore.

A heat recovery system is described for recovering part of the thermal energy in the effluent from the Hanford N-Reactor or a similar power reactor. The system operates on the Rankine cycle and involves vaporization of the working fluid in a boiler, isentropic expansion through a turbine, condensation, and pressurization back to vaporization pressure. The proposed system operates in the temperature range of 75 to 170°F with Genetron 133a as the working fluid. The most critical nonconventional requirement for ensuring the success of the system is a turbine designed specifically for the working fluid and with an efficiency of 90%. A successful system of this type would produce 400 MW(e) at a cost of 3 mills/kw. (H.D.R.)

27404 (CVNA-285) CHEMICAL SURVEILLANCE OF THE CAROLINAS-VIRGINIA TUBE REACTOR. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug. 1967. Contract AT(30-1)-2289. 149p. Dep. CFSTI.

For Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.

The chemistry program for the Carolinas–Virginia Tube Reactor is described and includes: variations in coolant and moderator chemistry and crud levels as a function of time; demineralizer and filter effectiveness; water chemistry stability with and without a demineralizer; distribution of radio-nuclides on surfaces; and inspection of various component surfaces exposed to the primary coolant, moderator, or other fluids. (auth)

27405 (DOCKET-50267-2) FORT ST. VRAIN NUCLEAR GENERATING STATION, [UNIT 1]. [Preliminary Safety Analysis Report], Amendment 11. (Public Service Co. of Colorado, Denver). Mar. 21, 1968. 200p. Dep. CFSTI.

The design of the thermal barrier for the Fort St. Vrain Power Reactor prestressed concrete reactor vessel is described. The basis for the change from metallic to fibrous insulation is given; effects of the change on previously submitted accident results are evaluated. The design changes in the stream generator dump system are summarised. The research and development program for Fort St. Vrain is outlined. An analysis of effects of a simultaneous loss-of-coolant accident and earthquake occurrence is given. (M.L.S.)

27406 (DOCKET-50300-3) EASTON NUCLEAR STATION. Preliminary Safety Analysis Report, Amendment 3, Suppl. 3, Exhibit B-3. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Apr. 16, 1968. 26p. Dep. CFSTI.

Information pertaining to the flood response of dams upstream of Easton Power Reactor is included; acceleration response spectra for a design earthquake are given. NDTT control of ferritic steel parts of the reactor coolant pressure boundary is discussed. Residual heat removal (RHR) system heat exchanger design criteria are given. Tritium production and control are discussed. (M.L.S.)

27407 (DOCKET-50309-6) MAINE YANKEE ATOMIC POWER STATION. [Preliminary Safety Analysis Report], Amendment 5. (Maine Yankee Atomic Power Co., Wiscasset). Apr. 8, 1968. 112p. Dep. CFSTI.

A tabulation of Class I vessels is given; compliance with the ASME nuclear pressure vessel code is outlined. Sample calculations of core hot channel factors and enthalpy rise factors are given for the worst time in core life and for design overpower conditions; complete results of calculations are tabulated. The number of fuel rods reaching design limits is shown as a function of power level. Procedures for restoring an isolated primary coolant loop to operation are outlined. System pressure is given as a function of size of failed pipes in event of coolant loss accidents. The extent of clad failure and fuel melting, in event of safety injection system failure, is analyzed. Various aspects of the design and operation of the safety injection system are discussed. Locations, ranges, detector types and sensitivities of the site monitoring systems are considered. Administrative control procedures for radiation exposure of plant personnel are given. (M.L.S.)

27408 (DOCKET-50309-7) MAINE YANKEE ATOMIC POWER STATION. [Preliminary Safety Analysis Report], Amendment 6. (Maine Yankee Atomic Power Co., Wiscasset). Apr. 17, 1968. 61p. Dep. CFSTI.

Information on containment construction and construction procedures for Maine Yankee Power Reactor is given; testing procedures and quality control provisions are described. The research and development programs for fuel assembly design and reactor thermal and hydraulic design are outlined. Fission and corrosion product inventory for the primary coolant system is tabulated. Brief discussions of the coolant pumps and water level and temperature instrumentation in the neutron shield tank. (M.L.S.)

27409 (DOCKET-50320-1) OYSTER CREEK NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Vol. 1. (Jersey Central Power and Light Co., Morristown, N. J.). Apr. 29, 1968. 387p. Dep. CFSTI.

Information on Oyster Creek Power Reactor, Unit 2, is presented under the following main topics: Introduction and Summary; Site and Environment including appendices on engineering geology and foundation considerations, seismology, and ground water hydrology; and Reactor. (M.L.S.)

27410 (DOCKET-50320-2) OYSTER CREEK NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Vol. 2. (Jersey Central Power and Light Co., Morristown, N. J.). Apr. 29, 1968. 282p. Dep. CFSTI.

Information on Oyster Creek Power Reactor, Unit 2, is presented under the following main topics: Reactor Coolant System; Containment System; Engineered Safeguards; Instrumentation and Control; and Electrical Systems. (M.L.S.)

27411 (DOCKET-50320-3) OYSTER CREEK NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Vol. 3. (Jersey Central Power and Light Co., Morristown, N. J.). Apr. 29, 1968. 276p. Dep. CFSTI.

Information on Oyster Creek Power Reactor, Unit 2, is given under the following broad topics: Auxiliary and Emergency Systems; Steam and Power Conversion System; Radioactive Wastes and Radiation Protection; Conduct of Operation; Initial Tests and

Operation; and Safety Analysis including core and coolant boundary protection analysis and standby safeguards analysis. (M.L.S.)

27412 (EURAEC–1982) USE OF GARIGLIANO PLANT COMPUTER FOR AUTOMATIC CALCULATIONS RELATING TO PLANT OPERATION. Special Report No. 5. Jovine, Riccardo; Cammarota, Umberto; Cruciani, Gianni (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Nov. 1967. Contract 101-63-11-RDI. 82p. (EUR–3780). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Descriptions, specifications, and block diagrams of codes used to analyze experimental data by the computer at the Garigliano nuclear power plant are presented. The codes permit rapid and accurate examination of data from wire irradiations, gamma scanning of fuel elements, period and coefficient of temperature measurements, and reactivity calculations. A best-fitting code is used to obtain statistical computation and functional correlation of any group of experimental data. (H.D.R.)

27413 (GA–8032) PROGRESS IN OPTIMIZING THE GAS-COOLED FAST BREEDER REACTOR. Shanstrom, Raymond T. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). June 29, 1967. Contract AT(04-3)-167. 19p. (CONF-671101–5). Dep. CFSTI.

From Annual Meeting of the American Society of Mechanical Engineers, Pittsburgh, Pa.

Fuel-cycle cost results are presented for variations in the design of a 1000 MW(e) gas-cooled fast breeder reactor. Principal performance characteristics of the reference design are compared with values for both gas-cooled and water-cooled thermal reactors. Fuel-cycle cost sensitivity to variations in the gas-cooled fast breeder parameters is discussed, and indications for future improvement in the design are examined. (H.D.R.)

27414 (GAMD–8371) EVALUATION OF CANDIDATE GRAPHITES (AND CARBON) FOR PSC CORE-SUPPORT APPLICATIONS. Meyers, C.; Koyama, K. (Gulf General Atomic, Inc., San Diego, Calif.). Feb. 6, 1968. Contract AT(04-3)-633. 138p. Dep. CFSTI.

The core-support graphite components provide the vertical support and the lateral restraint for the reactor core and reflector. The assembly consists of 37 core-support blocks of hexagonal cross-section, each approximately 37 in. between the parallel prism faces. Surrounding these blocks are 24 reflector support blocks keyed to the hexagonal blocks under the core and to the core barrel. Each of these graphite blocks is supported by three graphite posts with spherical ends to permit them to rock and accommodate the differential expansion between the various parts of the assembly. Normal operating temperature for the core-support blocks will be 777°C; for the core barrel 482°C; and for the core-support floor 54°C. Five samples of each grade, orientation, and type of graphite were tested. Mechanical testing consisted of tensile, compressive and flexural tests at room temperature (70°F) to measure ultimate tensile strength, ultimate compressive strength, modulus of rupture, and modulus of elasticity and density. Coefficient of thermal expansion and thermal conductivity were measured over the temperature ranges: 22 to 1000°C and 22 to 800°C, respectively. Description of test procedures and results are presented. (auth)

27415 (GEAP–5585) POWER REACTOR HIGH PERFORMANCE UO_2 PROGRAM. Progress Report Number 5, July 1–December 31, 1967. Ogawa, S. Y. (comp.) (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Jan. 1968. Contract AT(04-3)-189. 14p. (EURAEC–2000). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Description of the planned program for testing the burnup characteristics of UO_2 sintered pellet and compacted powder fuel elements with Zircaloy-2 cladding is presented. The core configurations are included for sintered pellet and compacted powder assemblies. The fabrication of the fuel assemblies is described. (D.C.C.)

27416 (ORNL–4228) NUCLEAR SAFETY PROGRAM ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1967. (Oak Ridge National Lab., Tenn.). Apr. 1968. Contract W-7405-eng-26. 487p. Dep. CFSTI.

REACTOR FUEL ELEMENTS—fission product release from Zircaloy clad uranium oxide (UO_2); radiation effects on Zircaloy clad uranium oxide (UO_2), examination of; fission gas diffusion in Browns Ferry, determination in; Zircaloy cladding for experimental TREAT, calculation of temperatures of; oxidation of high-temperature gas-cooled, results of in-pile; thermal conductivity calculations for pyrolytic carbon coated; shipping cask design criteria for spent

IODINE ISOTOPES I-130—release from failed Zircaloy clad uranium oxide (UO_2) fuels

FISSION PRODUCTS—diffusion coefficient for, determination of; mixtures of fuels and chemical equilibria of; deposition of, boundary-layer analysis of effects of

BROWNS FERRY POWER REACTOR, UNIT 1, BROWNS FERRY POWER REACTOR, UNIT 2—fuel elements for, empirically determined fission gas diffusion coefficient for

AEROSOLS—isotopic concentration of, determination using CMF portable sampler of; weight of disperse phase, agglomerated stainless steel, distribution of; concentration of, variation with time of airborne

CONTAINMENT MOCKUP FACILITY—aerosol generation in, determination of isotopic content for; containment vessel for, determination of fission product distribution in

IODINE—concentration measurements using CSE sampler; behavior in NSPP containment system; removal from containment systems atmospheres, efficiency of charcoal filters for; removal from air, efficiency of silver screens for; removal from gas streams, efficiency of scrubbers for; mass transport coefficients for; removal from gases, effects of sprays on mass transfer rate for

CONTAINMENT RESEARCH INSTALLATION—containment vessel for, determination of concentration of airborne activity in; containment vessel for, determination of concentration of airborne activity in; containment vessel for, effects on airborne activity of sprays in; containment vessel for, steam condensation rates in; description of; containment vessel for, determination of fission product distribution in

ORNL RESEARCH REACTOR—test facilities in, distribution of iodine-131 and cesium-137 in coolant loss accident mockup in; test facility for, fission gas release from fuel elements in poolside

IODINE ISOTOPES I-131, CESIUM ISOTOPES Cs-137—distribution in coolant loss accident mockup in ORR

REACTOR FUELS—mixtures of fission products and, chemical equilibria of; reaction rates for steam and, effects of temperature on; reaction of steam and pyrolytic carbon coated, rates of

NUCLEAR SAFETY PILOT PLANT—containment vessel for, behavior of airborne iodine in

CHARCOAL—filters of, characteristics of iodine; filters of, effects of heat on; ignition temperatures for, effects of fission product decay heat on; ignition data for, mathematical model for quantitative analysis of

METHANE, IODO—removal from containment systems atmospheres of, efficiency of charcoal filters for; removal from flowing steam-air atmosphere, effects of relative humidity on; formation of, effects of radiation on; mass transfer to water of, determination of factors affecting; mass transport of, effects of pH and temperature on; mass transport coefficients for; removal from gases, efficiency of spray systems for

FILTERS—efficiency of, effects of moisture on; fibers for, determination of diameter distribution of; design and construction of high-efficiency, engineering manual on

CASCADE IMPACTORS—collection characteristics of ORNL-developed; calibration curves for

MEMBRANE FILTERS—permeability of, effects of pressure variation on; permeability of, effects of carrier gas on

XENON—permeability through permselective membrane filters, effects of carrier gas on

MASS TRANSFER—effects on iodine, spray additive type and concentration; coefficients for iodine and methyl iodide

SPRAY COOLING SYSTEMS—methyl iodide mass transfer coefficients for

SPRAYS—solutions for, radiation effects on

HYDROGEN—production of radiolytic, effects of chemical properties of spray solutions on

GRAPHITE—reaction rates for steam and, effects of temperature on

STEAM—reaction with fuels and graphite, effects of temperature on rate of

REACTORS, GAS-COOLED—fuel elements for high temperature, results of in-pile oxidation of

MOLTON SALT BREEDER REACTOR—response of, effects of step reactivity input on; response of, effects of pump coastdown on; stability of, nodal model analyses of; heat generation rate in, effects of fission product buildup on

STEEL—time-temperature history during quench of heavy section; ultrasonic inspection of heavy section plate, quenching effects on results of

NOZZLES—stresses on, comparison of theoretical and experimental

REACTORS, POWER—pipes for, design criteria for; pumps for, design criteria for; valves for, design criteria for; antiseismic design of, research program for
REACTORS—RDI Standards Program for, listing of standards for; CHORD-S program for data on, description of hardware and procedures development for
REACTOR SAFETY—Nuclear Safety Information Center, summary of 1967 activities of
REACTOR SAFETY EXPERIMENTS—accidents in TREAT, simulation of transient (M.L.S.)

27417 (WCAP-3385-14) SAXTON PLUTONIUM PROGRAM. Semiannual Progress Report for the Period Ending December 31, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Mar. 1968. Contract AT(30-1)-3385. 31p. (EURAEC-1955). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Burnup data on the PuO_2-UO_2 partial core of the Saxton reactor are presented. After 850 equivalent full power hours the average burnup was calculated to be 13,000 MWD/MTM with peak burnup calculated to be 24,075 MWD/MTM. Predicted fuel burnup and isotopic compositions of four low burnup rods are compared to those determined using the chemical and spectrometric data. The fission gas release calculations are compared to the experimental results. (D.C.C.)

27418 (ANL-Trans-600) CORROSION OF V-ALLOYS IN LIQUID Na UP TO 600°C. Borgstedt, Hans Ulrich (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from a German report. 26p. Dep. CFSTI. JCL $2.60 fs, $1.10 mf.

Corrosion experiments were performed on binary and ternary V-alloys in flowing Na at 500 to 600°C as part of development work on potential cladding materials for fuel elements for a Na-cooled fast breeder reactor. The effects of test duration, corrosion mechanisms for various compositions, and Ca and O impurities in the Na were examined for alloys of V with Ti, Nb, Al, Cr, Zr, Mo, and Si with trace additions of C, Y, and Ce. (H.D.R.)

27419 (NP-tr-1655) PROCESS AND SYSTEM OF ENERGY PRODUCTION. Maillet, E. Translated by W. G. Stripp for Atomic Energy Research Establishment, Harwell, Eng., from French Patent 1,408,858. 16p. Dep. CFSTI. UK. JCL $1.60 fs, $0.80 mf.

A process and an arrangement for the production of energy by recovery of the heat produced in a CO_2 gas-cooled is described. The coolant constitutes the driving fluid of a gas turbine and circulates in a closed circuit between the reactor and the turbine. The maximum pressure attained by CO_2 after compression is between 120 and 250 bars. The pressure of the CO_2 in the reactor is between 40 and 120 bars. The minimum pressure of the fluid, after the principal expansion, is greater than 15 bars. Compression of the gas is carried out in at least two stages separated by intermediate cooling. (tr-auth)

27420 (ORNL-tr-1825) TREND IN ATOMIC POWER GENERATION AND URANIUM RESOURCES. Kamiyama, Teiji. Translated by H. Kubota (Oak Ridge National Lab., Tenn.), from Genshiryoku Kogyo, 13: No. 2, 5-8(1967). 14p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Evaluation of the present trend in atomic power development and uranium supply is presented. Analysis of natural uranium resources in the free world is presented and requirements to 1985 are listed. Economics of ore processing and recovery for predicted requirements and uranium supply are described. (D.C.C.)

27421 S. A. NUCLEAR DESIGN WOULD PRODUCE TOO MUCH POWER. S. Afr. Mining Eng. J., 78: 2491(Oct. 6, 1967).

Despite enormous reserves of coal, a vigorous nuclear power research project has been under way in South Africa for several years. Based essentially on the availability of cheap, large reserves of domestic U, the design concept utilizes natural U fuel with heavy water moderation and liquid metal cooling. Features of the system, which are unconventional, include the use of unclad fuel elements in the form of small spheres in direct contact with the liquid Na coolant, and the employment of moderator displacement by He gas to control the reactor. The most important advantage of this is the prospect of high specific power density, in excess of 40 W/g, based on a minimum effective plant capacity of ~1000 MW(e). However, units of this size are not expected to be introduced in the South Africa electrical grid for ~15 yr. Other aspects of the requirements of nuclear power in African nations are discussed. (auth)

27422 NUCLEAR ENERGY AND THE ELECTRIC POWER INDUSTRY. Ward, J. Harris EEI (Edison Elec. Inst.) Bull., 35: 418-22(Dec. 1967).

The need of clarifying the political, social, and legal aspects of large-scale nuclear power generation, now an operating and engineering reality, is emphasized. The implications of nuclear generation for the structure of the power industry, and its tendency to further discourage small operators and small plants are discussed. The problem of government vs investor-owned units is taken up and it is concluded that many regulations applicable to public-owned utilities would impede the efficient growth and development of large power units. Shared partnership will work only in the case of roughly equal partners, both having substantial generating capacity; the Quad-Cities 1600-Mw station is quoted as an example of both the advantages and difficulties in this field, the latter particularly with regard to the economics of yellow cake. It is argued that while regulation is necessary, it is essentially technical and should, in view of the complex technology of nuclear reactors, remain the responsibility of the AEC instead of being subjected to the regulatory powers of extraneous agencies. The problem of obtaining skilled and experienced personnel in all areas of commercial nuclear power generation is considered also to favor large entities, as many complex questions of organization and nuclear expertise must be efficiently solved. Fuel management, which exacts large investments and imposes requirements of optimum in-core fuel utilization, is cited as a typical example of the problems facing the producer of nuclear power/and indicating a trend towards large-scale producers. (BBB)

27423 EEI PARTICIPATES IN DEMONSTRATION PROGRAM OF PLUTONIUM FUEL IN A FAST BREEDER. EEI (Edison Elec. Inst.) Bull., 35: 432-3(Dec. 1967).

A research project on the use of Pu in fast reactors is described to demonstrate Pu as a fast reactor fuel. The program evaluated the economics of mixed oxides (PuO_2-UO_2); their operating characteristics in a fast reactor; the radiation behavior of fuel based on a full-core loading; and the commercial manufacture of a core of mixed-oxide fuel. The preliminary Phase I work included: the preparation for radiation testing of mixed oxide fuel in a fast reactor at an early date; the design of a PuO_2-UO_2 core for a fast reactor; reactor safety evaluation; fuel fabrication development and fabrication of radiation test specimens; and the design and fabrication of 3 fuel test subassemblies for radiation testing in Na at up to 1200°F. The 24 fuel pins have an effective length of 30 in. and an outer clad dia of 0.25 in., and a clad thickness of 0.016 in.; the candidate clad material is either Type 316 or Type 347 stainless steel. The reference fuel, Pu_2O-UO_2 pellets of about 88% of theoretical density, should lead to a high burnup based on design criteria that consider internal pressure buildup resulting from fission gas release and fuel swelling. Two pin designs using pellet fuel and one design in which the fuel is introduced into the clad and the desired density achieved by vibrating the clad were used for the manufacture of 3 prototype specimens of each design. The subassembly design is such that, with a full core loading in the Enrico Fermi reactor, a reactor power of 430 MWt (150 MWe) could be achieved with Na temperatures in the reactor at 600°F bulk inlet and 900°F bulk outlet and steam conditions of 865 psia and 780°F. The design allows for a full core loading of Pu or for partial loadings of Pu and ^{235}U. The breeding ratio for an all Pu core would be 1.3 or greater. (BBB)

27424 SCOTTISH NUCLEAR STATION. S. Afr. Mining Eng. J., 78: 3010(Dec. 1, 1967).

One of the U.K. Atomic Energy Commission's largest undertakings is the Dounreay Establishment, situated on the Caithness coast near Thurso in Scotland. It comprises the experimental power-producing fast reactor (D.F.R.) and a smaller, materials testing reactor (D.M.T.R.). Associated with these reactors are extensive facilities for the production and reprocessing of enriched fuel elements and for their examination after irradiation. The high power Prototype Fast Reactor (P.F.R.) under construction will be operational in 1971 and will generate 250 Mw of electricity at full power for the North of Scotland Hydro Electric Board. The D.R.F. attained its full power of 60 Mwt in July 1963 and since then has been used primarily as an irradiation test facility for future fast reactors. The core can accommodate 324 fuel elements or test samples and the blanket 1872 breeder elements of natural U. The driver charge of fuel consists of enriched U in the form of hollow rods, canned in Nb. The heat produced in the core is removed by liquid Na-K alloy, and transferred to a secondary liquid metal circuit in the primary heat exchangers. These heat exchangers and the reactor are enclosed in a concrete vault within the 135 ft dia steel sphere. The Materials Testing Reactor is an enriched U thermal reactor moderated and cooled by heavy water and is used as an irradiation facility for experimental work. The reactor is housed in a sealed cylindrical steel building 70 ft high by 70 ft in dia which also contains the heat exchangers, storage tanks, and the reactor control room. The Metallurgy Division is responsible for the development and fabrication

of fuel elements for the D.F.R. and M.T.R. reactors and for the postirradiation examination of fuel elements and other reactor materials. There are also lab facilities which provide a complete metallurgical service to the site. (BBB)

27425 NEW APPROACHES IN REACTOR TECHNOLOGY. Merkle, T. C. (Univ. of California, Livermore). pp 21-30 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

The evolutionary future of nuclear reactors is discussed by examining some possible technological pathways in their development. Adaptations of reactors for application under the seas, inside the earth, on the surfaces of moons and planets, and in empty space are examined. (H.D.R.)

27426 WEST GERMANY'S H.T.R. SPHERICAL-ELEMENT REACTORS. Casa, A. F.; Sansone, M. Com. Naz. Energ. Nucl., Notiz., 14: 43-57(1968). (In Italian).

A discussion of the high-temperature-reactor programs at present in progress in Germany, with special regard to the A.V.R. Jülich reactors, to the 300 MWe T.H.T.R. prototype now being completed and to the fuels used in these facilities is presented. (auth)

27427 NUCLEAR ENERGY REVOLUTION AND CHEMICAL PROCESSING. Weinberg, Alvin M.; Young, Gale (Oak Ridge National Lab., Tenn.). pp 1-19 of Recent Advances in Engineering Science. Volume 2. Eringen, A. C. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1965.

From 3rd Technical Meeting of the Society of Engineering Science, Davis, Calif. See CONF-651137-(Vol.2).

An optimistic assessment is presented of nuclear energy and its future role, particularly in the chemical processing industry. The reductions in the capital costs of large reactors are pointed out, and it is felt that nuclear power will become the cheapest form of energy. The use of nuclear power to desalt sea water and to produce hydrogen and ammonia is discussed in some detail. (D.L.C.)

27428 ENERGY SOURCES IN THE AMERICAN ELECTRIC ECONOMY. Kroms, A. Bull. Ass. Suisse Elec., 58: 923-9 (Sept. 30, 1967). (In French).

Sources and uses of energy in the United States are compared with those of the entire world, and predictions of consumption in 1980 and 2000 are made. Data relating to nuclear energy are as follows. Determined usable reserves of U: world, 0.9 to 1.2×10^{18} BTU; U. S., 0.3×10^{18} BTU; U. S. in %, 25 to 33%. Potential additional reserves of U: world, 4×10^{24} BTU; U. S., 224×10^{21} BTU; U. S. in %, 6%. Potential additional reserves of Th: world, 5.6×10^{24} BTU; U. S., 333×10^{21}; U. S. in %, 6%. Predicted consumption between 1960 and 2000 of U and Th of the U. S., 0.2×10^{18} BTU, 67% of determined usable reserves but insignificant fraction of potential additional reserves. Sources of energy for electric enterprises in 1975 are: hydraulic energy, 12 to 13%; fossil fuels, 80 to 82%; nuclear energy, 5 to 8%. In 1980: hydraulic energy, 10 to 12%; fossil fuels, 70 to 80%; nuclear energy, 10 to 18%. In 2000: hydraulic energy, 4 to 6%; fossil fuels, 40 to 46%; nuclear energy, 50 to 54%. (BBB)

27429 SOURCES OF ENERGY OF THE AMERICAN POWER INDUSTRY. Kroms, A. Bull. Ass. Suisse Elec., 58: 959-64 (Oct. 14, 1967). (In French).

Nuclear power plants are reviewed. The power of nuclear plants now in service is 2,300 MW. They have delivered 30×10^9 kWh to the grid. More than 50% of electric power units ordered in 1966 were for nuclear stations, and the trend continued in 1967. In the first half of 1967, 23 power plants were planned with a total power of 18,000 MW. Group size varies between 600 and 1000 MW. Power of plants under construction, scheduled for service by 1973, is 50,000 MW. By 1980 nuclear power plants will reach 140,000 MW and comprise 25 to 30% of total electric power. These figures are three times the amounts predicted two years ago and can be expected to increase even further. Most plants are built near the coasts. Plants using coal and nuclear sources are of comparable economy now. By 1970 to 1980 the price of power will be controlled by nuclear power and will be lower, for a fixed dollar value, than at present. Consumption of U will require working of low grade deposits or importation from Canada. Other reactors, converters and breeders, are envisaged to lower usage of U. It is important for the U. S. to incorporate the fast breeder as soon as possible in the production of energy. (BBB)

27430 STATE RESPONSIBILITIES IN THE SITING OF NUCLEAR FACILITIES. Dunnington, Frank G. (Rutgers-The State Univ., New Brunswick, N. J.). Amer. J. Publ. Health, 57: 2023-8(Nov. 1967).

The role of state health departments in the choice of locations for nuclear installations is examined. Some of the environmental changes which may be caused by a nuclear facility and which are the responsibility of the state government are discussed, and the action required by the state government is illustrated by using New Jersey as the example. It is the basic responsibility of a state department of health to be informed of any environmental changes brought about by any nuclear facility, but the Atomic Energy Commission reviews nuclear reactor design and sites, and licenses reactors, on the basis of radiological health considerations. Thus the question of pre-emption, or federal versus states rights, is raised and is briefly discussed. (BBB)

27431 WORLD NUCLEAR POWER DEVELOPMENTS. S. Afr. Mining Eng., J., 78: 2694-2700(Oct. 27, 1967).

The swing to nuclear power throughout the world over the past 2 yr has modified all the earlier forecasts of its adoption and U requirements. In the U. S. in 1966, orders were placed for 20 new nuclear stations and in 1967, for another 50. This brings the total number of nuclear power plants in operation, under construction, or definitely planned to 184, having a total generating capacity of 67,000 MW. Also, Japan, Italy, Spain, and the United Kingdom have expanded their nuclear programs and EURATOM now predicts that about 60,000 MW of nuclear power capacity will be operating in the European Economic Community by 1980, and thereafter about ⅔ of all new generating power will be nuclear. The U. K. Atomic Energy Authority predicts that 33 countries (accounting for 90% of the Free World's present power-generating capacity) will have a total nuclear generating capacity of 344,000 MW by 1985. Other predictions indicate that the Free World installed nuclear capacity will range from 321,000 to 507,000 MW by 1985, with 130,000 to 212,000 MW being installed in the larger European countries. This expansion in capacity has been the subject of a study by the Australian Atomic Energy Commission, the main points of which are discussed. The present and projected programs of various nations are examined, as are some of the reasons underlying the accelerated shift to nuclear power. (BBB)

27432 MAINTENANCE RECORDS IN THE NUCLEAR AGE. Bus. Sys. Equip., 18-22(Nov. 1967).

At Dungeness power station in the U. K., Addressograph equipment is being used for a mechanised record-updating system tailored to large plant maintenance conditions. A detailed description of the system is given. (auth)

27433 DESIGN QUESTIONS OF THE THTR. Schmiedel, F. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). pp 125-8 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

The principal design questions of the THTR, a thorium high temperature reactor using spherical fuel elements, are outlined. The shielding problems were determined by a stressed concrete vessel, integrated construction of vaporizer and blower, and the use of ceramic fuel elements. (J.S.R.)

27434 DEVELOPMENT OF CONSTRUCTION PRINCIPLES OF BREEDING CORES AND OUTGOING RADIATION FIELD. Seetzen, J. (Kernforschungszentrum Karlsruhe, Ger.). pp 129-39 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

Cross sections are given of the construction of a 1000 MW(e) Na-cooled and a steam-cooled breeder. The neutron spectra and neutron flux through the shield and heat source for a Na-cooled fast breeder and the neutron and gamma fluxes in the horizontal heat shield of a steam-cooled breeder are given to illustrate the problems to be considered in the shielding calculations for fast breeders. (J.S.R.)

27435 SPECIAL SHIELDING PROBLEMS IN FAST SODIUM-COOLED BREEDER REACTORS. Vossebrecker, H.; Weber, H. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). pp 141-2 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

In sodium-cooled breeders, special shielding problems occur as a result of the high power density. There are specific difficulties both in the loop and in the pool construction. For the loop construction method a possible solution was worked out. (J.S.R.)

27436 STRESSED CONCRETE SAFETY VESSELS FOR NUCLEAR POWER PLANTS WITH LIGHT-WATER COOLED REACTORS. Schnellenbach, G. (Technische Hochschule, Hanover). pp 155-81 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

The most important problems in the design and construction of stressed concrete safety vessels are discussed. These are the characteristics of pressed concrete as a building material, the construction method, the dimensioning of such a vessel, and the prestressing system. (J.S.R.)

27437 STRESSED CONCRETE PRESSURE VESSEL FOR NUCLEAR POWER PLANTS. Schuitz, H. (Technische Hochschule, Hanover). pp 183-201 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

Some engineering problems in the construction of reactor pressure vessels from stressed concrete are briefly outlined. The requirements that are placed on the pressure vessels are given. Tension determination and rupture behavior of the vessels are discussed. The temperature stresses placed on the reactor vessel are described. The techniques for the shaping and preparation of pressure vessels are summarized. (J.S.R.)

27438 COMPARISON OF COST DATA WITH NEUTRON PRODUCTION. Huber, Hans. Neue Tech., 9: 218-23(Dec. 1967). (In German).

The function of the various European power producing organizations is discussed with respect to the use of nuclear power. Calculation of fuel cycle costs is discussed; various aspects of construction and production costs for nuclear power plants are compared. (M.L.S.)

27439 NUCLEAR POWER TO CARVE OUT BIG GAINS. Oil Gas J., 65: No. 38: 52-4(Sept. 18, 1967).

By 1980 nuclear power will supply 10% of the energy consumed in the US. It will power a quarter of all electric generating plants. In western Europe growth will be even faster; by 1980 nuclear plants will provide 12% of energy demands. Virtually the entire growth will be in plants generating electricity, and only exceptions will be for minor use in desalting water and in providing process heat. (UK)

27440 FAST REACTOR DEVELOPMENT IN THE UNITED KINGDOM. Kronberger, H. Atom, No. 138, 92-100(Apr. 1968).

Text of paper presented to Institute of Atomic Studies, Bucharest, December 1967. (UK)

27441 COST OF QUALITY IN NUCLEAR ENGINEERING. Heal, T. J. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Metals Mater., 2: 107-10(Apr. 1968).

The emphasis is on experience in the design and manufacture of fuel elements for the first generation of U. K. nuclear power stations. Headings are as follows: meaning of quality; quality conformance; cost of design quality; user experience. (UK)

27442 CALORIMETRIC PROBES FOR IN-PILE MEASUREMENTS. Kott, Josef (Skoda Works, Plzen, Czechoslovakia). Tech. Dig. (Prague), 9: 537-41(Aug. 1967).

Reactor calorimeters under development for application in the first Czechoslovak nuclear power station are described. Radial, axial, and tabular calorimeters for measuring radiation heating in reactor components at dose rate levels up to 1 W/g are examined, and their calibration is discussed. (H.D.R.)

27443 PWR'S: HOW THEY'VE GROWN TO TODAY'S SIZE. Farbman, G. H.; Jacobs, J. H. (Westinghouse Electric Corp., Pittsburg). Power, 112: No. 4, 69-78(Apr. 1968).

The progress in pressurized water reactor technology is illustrated by comparing some of the parameters of operating plants to plants scheduled for operation in the early 1970's. The two basic factors responsible for improved performance—larger components and improved heat extraction efficiency—are examined in detail. (H.D.R.)

27444 NUCLEAR POWER PLANT SAFETY. Strauss, S. D. Power, 112: No. 1, 159-66(Jan. 1968).

The engineered safeguards used in water-cooled power reactors to prevent the accidental release of fission products are described. Design features and reliability of emergency core cooling systems to prevent melting of fuel element cladding and pressure suppression systems to prevent fission-gas outleakage from the containment are examined. (H.D.R.)

27445 COMPUTERIZED TESTING AT WYLFA. Engineering, 205: 550-2(Apr. 12, 1968).

Progress with the construction and commissioning of Wylfa nuclear power station is summarized. The computerized control and instrumentation system is described. (UK)

27446 HEAT TRANSFER EXPERIMENTS ON A HEATING STRIP WITH A LONGITUDINAL FLOW FOR REYNOLDS NUMBERS BETWEEN 5×10^3 AND 10^6. Hammeke, K.; Heinecke, E.; Muenchow, K. (Kernforschungsanlage, Juelich, Ger.). Brennst.-Waerme-Kraft, 20: 71-6(Feb. 1968). (In German).

For the high pressure gas channel of the Julich nuclear research station a heating installation was required with an electrical power of maximum 2 MW to be installed in a channel volume of 1 m^3. Heat transfer experiments on a previously fabricated heater and a further heater forming part of the later erected installation showed that the heat transfer on a rectangular 3.5 mm by 45 mm cross-section profile in the investigated range of the Reynolds Number can be described by the average curve for bodies of different shapes proposed. 16 references. (auth)

27447 STEAM GENERATING HEAVY WATER REACTOR. London, United Kingdom Atomic Energy Authority, 1968. 36p.

A fully illustrated descriptive pamphlet is presented, with the following headings: what is the SGHWR?; how it started; supporting research; construction; the reactor; the fuel; the coolant; electricity; control; the moderator; future of SGHWR. (UK)

27448 BRITTLE FRACTURE STRENGTH OF THICK STEEL PLATES FOR REACTOR PRESSURE VESSELS. Kihara, Hiroshi; Ikeda, Kazuo. Papers of Ship Research Institute No. 9. Tokyo, Ship Research Inst., 1966. 35p.

Testing methods and results for brittle fracture strength of the Tokai-mura Power Reactor pressure vessel are presented. The testing methods include: Robertson test, double tension test, and the ESSO test. Effects of neutron irradiation damage and high temperature prestraining on transition temperature are described. (D.C.C.)

27449 TEPLO-FIZICHESKIE SVOISTVA MATERIALOV YADERNOI TEKHNIKI. (Thermo-Physical Properties of Materials of Nuclear Technology. Handbook). Chirkin, V. S. Moscow, Atomizdat, 1968. 484p.

A review is given on the research carried out by the Institute of Physics and Power Engineering on fast neutron reactors. Thermodynamics and technology of liquid metal coolants are grouped in four chapters: heat transfer in circular, ring and square shaped channels; heat exchange and hydrodynamics in complex channels; boiling and condensation of metals; and technology of operation with liquid metals. A supplement covers recommended methods for calculations of heat transfer in liquid metals, data on corrosion resistance, and temperature endurance of certain construction materials in liquid sodium. The data are of use in calculations for liquid metal-cooled nuclear power plants. (R.V.J.)

27450 PROBLEME DES BAUTECHNISCHEN STRAHLENSCHUTZES. II. VORTRAEGE GEHALTEN AUF EINER SITZUNG DES FACHAUSSCHUSSES III STRAHLENSCHUTZ AM 13./14. OKTOBER 1966. (Problems of Structural Engineering in Radiation Protection. II. Lectures Presented at a Meeting of the Third Professional Committee on Radiation Protection, October 13-14, 1966). Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Berichte der Studiengesellschaft zur Foerderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V., Hamburg (KERNENERGIE-Studiengesellschaft, KEST). Nr. 10. Munich, Verlag Karl Thiemig KG, 1967. 266p. DM 24.80 (In English and German). (CONF-661060).

Included are 20 papers on the theory, geometry, materials, and fabrication of radiation shielding and on the design, analysis, and fabrication of pressure vessels for nuclear reactors. Separate abstracts were prepared for 17 papers. Abstracts of 3 papers appear in NSA as 21: 13782, 21: 39389, and 21: 41170. (H.D.R.)

For abstracts of individual papers see: 26160, 26444–26450, 27433–27437, 27452, 27454, and 27498–27499.

Marine and Portable Power Reactors

27451 DESIGN OF A MARINE NUCLEAR POWER PLANT UTILIZING THE DIRECT BRAYTON CYCLE. Gathy, Bruce Stephen (Coast Guard Academy, New London, Conn.). Nav. Eng. J., 79: 887-95(Dec. 1967).

Application of the direct Brayton cycle to a marine power plant was explored. A gas-cooled reactor, gas turbines, and a waste-heat boiler were incorporated to provide heat energy, propulsive

power, and auxiliary steam, respectively. The system was applied to a large passenger ship. The maximum open cycle efficiency occurred at a pressure ratio of 5.0 for the inter-cooled and regenerative cycle, with the minimum total system pressure loss. Incorporating a waste-heat boiler reduced the cycle efficiency but led to a higher over-all plant efficiency. An air filtering system can effectively clean and dry the air of an open cycle but it is impractical to clean the radioactive effluent. The closed-cycle is as efficient as the open cycle and it has some advantages over it. The ambient pressure can be increased giving rise to smaller equipment. It gives a flatter efficiency curve for large operating ranges. The working fluid best suited for a closed nuclear cycle is He. The 630A nuclear steam generator can be redesigned to deliver 106 MW, and it can be incorporated into the closed Brayton cycle. A fuel loading of 1.362×10^4 pounds of UO_2, enriched to 3.23% has a maximum operating life of 6.37 yr and a burnup of 31,000 MWD/Mt. The completely contained and shielded reactor is 32 ft high and 21.5 ft in dia. (BBB)

27452 PROBLEMS IN THE PRODUCTION OF REACTOR SHIELDING WITH CAST IRON. Schilling, F. (Siempelkamp Giesserei KG, Krefeld, Ger.). pp 235-55 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

The shielding for the nuclear ship "Otto Hahn" is made of cast iron. The problems encountered in the manufacture of this shield are described and illustrated. (J.S.R.)

Rocket and Space Reactors

Refer also to abstract 26033.

27453 (NAA-SR-Memo-12425) HYDROGEN PERMEATION THROUGH SNAP-8 FUEL ELEMENT CLADDING ASSEMBLIES. Engberg, C. J. (Atomics International, Canoga Park, Calif.). Apr. 13, 1967. Contract AT(04-3)-701B. 13p. (CONF-670417-3). Dep. CFSTI.

From 69th Annual Meeting of the American Ceramic Society, New York.

The hydrogen permeability of SCB-1 and AI-8763D glass-enamels applied to Hastelloy N is shown to fit the simplified permeation equation, $F = K'A\,\Delta P \exp(-Q/RT)$ for the temperature range of 1200 to 1600°F. Thermal endurance permeation rates for ten SCB-1 coated cladding assemblies at 1500°F and 1 atm hydrogen pressure are presented. The simplified permeation equation was applied to endurance test data to show an expected hydrogen loss range of 1.75 to 2.5% in 10,000 hours for a typical SNAP reactor core. The calculated loss was about ⅓ to ½ the design goal of 5% hydrogen loss in 12,000 hours for SNAP-8 reactors. (auth)

27454 SHIELDING PROBLEMS IN THE APPLICATION OF NUCLEAR REACTORS IN SPACE. Hehn, G. (Technische Hochschule, Stuttgart). pp 113-24 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

In order to keep the weight as small as possible, the shielding for nuclear space vehicles is constructed in shadow geometry. The shielding materials considered are LiH, ^7LiH, borated graphite, tungsten alloys, and depleted uranium. The calculation methods must consider the radiation in the forward direction and these methods are outlined. The radiation field of the SNAP 10A and the weight optimization are diagrammed. The requirements placed on the components, such as the shape of the fission zone and the shape of the radiator, are discussed. The pay load of a nuclear space vehicle is estimated. (J.S.R.)

Process Heat and Desalination Reactors

Refer also to abstract 27427.

27455 (ORNL-4229, pp 188-90) SUPPORT FOR OTHER ORNL PROGRAMS. (Oak Ridge National Lab., Tenn.).

Progress is reported on studies of the unclad-metal-fueled fast breeder reactor and on chemical support for the controlled thermonuclear research program. (M.C.G.)

27456 OPTIMIZATION AND RANGE OF APPLICATION OF NUCLEAR REACTORS AND FLASH EVAPORATORS FOR SEA WATER DESALINATION. Aschner, F. S.; Yiftah, S.; Glueckstern, P. (Inst. of Tech., Haifa, Israel). Desalination, 3: 82-90(1967).

The distillation plants considered were of the multi-stage single-effect flash evaporator type. The dual-purpose plant research covered the range from 50-MW to 300-MW net power generation by back-pressure turbines and the desalination of sea water quantities which, under varying heating steam and evaporator design conditions, can be obtained by heating steam exhausted from back pressure turbines driving the electric generators; this corresponds to a range of water output between 10 and 200 mgpd (38,000 to 760,000 m^3/day). The single purpose plant investigation covered thermal reactor ratings in the range from 200 to 1600 MW corresponding to a range of water output as for the dual-purpose plant. The reactor types investigated were the pressurized water reactor, the boiling-water reactor, the heavy-water-moderated and -cooled reactor, the gas-cooled graphite moderator reactor, and the gas-cooled heavy-water-moderated reactor. Conventional plants at various steam pressures and temperatures were also considered for comparison. For single-purpose plants, low temperature PWR and HWN reactors and the concept of deep-pool light-water reactors were investigated. All plant types were defined by mathematical models and optimized technically and economically. The influence of the water cost of turbine exhaust temperature and of economic parameters, such as fixed charge rate and electricity value, is also analyzed. (BBB)

Research and Test Reactors and Critical Assemblies

Refer also to abstract 25631.

27457 (BNWL-513) POTENTIAL FFTF CARBIDE FUELS. Bailey, W. J.; Cohn, P. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1967. Contract AT(45-1)-1830. 89p. Dep. CFSTI.

Evaluation of the potential of UC–PuC or UC driver fuels for the Fast Test Reactor (FTR), an integral part of the Fast Flux Test Facility (FFTF), is described. Reactor core designs and fuel cycle parameters were investigated with a PNL adaptation of the MIDAS computer code and various carbide fuel combinations and operating conditions. Analyses of the various carbide fueled FTR's demonstrated that UC–PuC offers the possibility of an excellent FTR driver fuel from several aspects including cycle cost, flux, performance, fabrication requirements, and safety. (auth)

27458 (BNWL-514) POTENTIAL FFTF ALLOY FUELS. Bailey, W. J.; Aase, D. T.; Cohn, P. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1967. Contract AT(45-1)-1830. 100p. Dep. CFSTI.

Evaluation of the potential of Pu- and/or U-enriched alloy driver fuels for the Fast Test Reactor, an integral part of the Fast Flux Test Facility, is described. Reactor core designs and fuel cycle parameters were investigated with a PNL adaptation of the MIDAS computer code and various alloy fuel combinations and operating conditions. Analyses of the various alloy-fueled FTR's demonstrated that sodium-bonded alloy fuel, in particular U–Pu–Zr, offers the possibility of an excellent driver fuel from several aspects including cycle cost, flux, performance, and fabrication requirements. (auth)

27459 (BNWL-634, pp 3.1-27) THERMAL REACTORS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The program of experiments in the Phoenix-fueled PRCF-MTR mockup has been completed. The measurements have provided valuable information about the shutdown capability, kinetics parameters, and power distribution to be expected in the Phoenix fuel core planned for the MTR, and have provided data with which to test the computational methods currently being applied to Phoenix fuel cores. Calculations were performed to determine the feasibility of fueling a maritime reactor with plutonium Phoenix fuel. The Babcock and Wilcox (B&W) Consolidated Nuclear Steam Generator (CNSG-II) design was used as the base case. The reactivity, multiplication, and core lifetime characteristics were calculated for various plutonium Phoenix loadings. Physics calculations were performed to determine the feasibility of a plutonium Phoenix fuel loading in the PRTR. Nineteen-rod clusters of Al-Pu with a plutonium isotopic composition of 65.5/23.3/7.7/3.5% of $^{239}Pu/^{240}Pu/^{241}Pu/^{242}Pu$ respectively were considered. Core lifetimes in the range of 60,000 megawatt days were calculated. Physics calculations were performed to determine the feasibility of a thorium fuel loading in the PRTR. The fuel element types considered were nested metal cylinders of Th–4 wt % ^{233}U and 18 to 19 rod clusters of ThO_2-$^{233}UO_2$. Core lifetimes of 15,000 to

20,000 megawatt days were calculated. Measurements were made in the Physical Constants Test Reactor (PCTR) to obtain the adjoint weighted excess neutron production cross sections $\langle\Sigma_p\rangle$ for a 2.1% enriched uranium, 2.93 wt % lithium (42.8% ^{6}Li) in aluminum target supercell in a three-to-one ratio. Results were obtained for a test array utilizing a square shaped supercell building block, and a "T" shaped building block as the central supercell. Test array conditions were both wet (coolant water in process tube) and dry (no coolant water). Calculated values for the average supercell thermal neutron absorption cross section were used in conjunction with the values of $\langle\Sigma_p\rangle$ to obtain values of the infinite medium neutron multiplication factor, k_∞. These values of k_∞ are compared to the corresponding values obtained by the PCTR null reactivity technique. The agreement of the values for k_∞ is very good for these systems where k_∞ is very close to 1.0. (auth)

27460 (BNWL-634, pp 4.1-55) FAST REACTORS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A model of the FTR split core in x-y geometry was developed and extensive physics statics calculations were carried out for this configuration. The effect of adding BeO to the FTR reflector is being examined. Modest improvements in the Doppler coefficient seem achievable. These improvements are offset by the introduction of undesirable power gradients near the core reflector interface. The relative neutronic characteristics of stainless steel and Inconel side reflectors were compared. The Inconel reflector shows marked advantages over the steel reflector. An analysis of typical energy deposition patterns in the FTR was made. About 95% of the fission energy is deposited in the core, and 90% in the core fuel. A new, maximum hypothetical accident code, MAX, was developed. At present, this code is being used to generate parametric data for the FTR. The analysis of the Phase A experiments is almost complete and detailed plans for the Phase B experiments have been generated. An extensive evaluation of the functions and advantages of the NPTF was completed and documented. Safety studies for the NPTF were started. The possibility of using the NPTF/FTR system to detect anomalous behavior in the FTR via continuous on-line measurements of neutron noise is being examined. Analyses of the Al shielding experiments are continuing. Comparison of MAC (a removal diffusion code) and the discrete ordinate transport code ANISN is being made. An estimate of nuclear heating rates in the radial neutron shield and in the axial cover shield for use in the conceptual design of the shield cooling systems was made. Decay heat from irradiated FTR driver fuel was estimated using the computer program RIBD. Radioactivity levels and heat generation for unirradiated FTR driver fuel was also estimated. Work is continuing on the calculation of one group average capture cross sections for the 450 fission product isotopes. Current investigations have been concentrated on isotopes neighboring those which have significant radiological effects. (auth)

27461 (BNWL-SA-1066) FFTF FUEL ELEMENT DESIGN. Cohn, P. D.; Bailey, W. J.; Lobsinger, R. J.; Millhollen, M. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 27, 1967. Contract AT(45-1)-1830. 17p. (CONF-670602-28). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

Design analyses of FFTF fuel elements aimed at satisfying the high flux requirements of FFTF along with the implied safety and reliability goals are examined. Preliminary specifications are presented for mixed PuO_2-UO_2 fuel pins, fuel pin spacer bars, and fuel subassembly configuration for an 800 liter FFTF core with two radial fuel zones of equal volume. Fuel subassembly thermal and hydraulic performance, fuel form, exposure, and cycle data are also examined. (H.D.R.)

27462 (GA-8543) FAST REACTOR SPECTRUM MEASUREMENTS. Quarterly Progress Report for the Period Ending January 31, 1968. Preskitt, C. A.; Neill, J. M. (Gulf General Atomic, Inc., San Diego, Calif.). Feb. 23, 1968. Contract AT(04-3)-167. 30p. Dep. CFSTI.

The description of the core loading procedure of the Subcritical Time-of-Flight Spectrum Facility (STSF-1) is presented. The fuel assembly configuration of core drawers with up to 600 kG of 93% enriched uranium is described. Performance of time-of-flight experiments yielding spectral measurements at four positions is included. (D.C.C.)

27463 (IEA-130) CALCULO DA MASSA DE OXIDO DE URANIO PARA O ARRANJO SUB-CRITICO RESSUCO. (Calculation of the Mass of Uranium Oxide for the Subcritical Assembly Ressuco). Franzen, H. R.; Foshina, Mioco; Mazzilli, Elenice (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec. 1966. 22p. (In Portuguese). Dep.

Formulas are presented for obtaining the mass of uranium oxide in the subcritical assembly Ressuco moderated with light water. The choice of each fundamental expression was made according to a numerical test based on the characteristics of the lattice arrangements of uranium oxide whose cladding was of aluminum or steel. An IBM 1620 Model II computer was used in all the calculations for the determination of the mass of fuel for the subcritical Ressuco. (auth)

27464 (IN-1179) A PRIMARY STUDY ON THE COMPRESSIVE PROPERTIES OF COMPOSITE NUCLEAR FUEL PLATES. Sumpter, K. C. (Idaho Nuclear Corp., Idaho Falls). Apr. 1968. Contract AT(11-1)-1230. 22p. Dep. CFSTI.

Compression stress-strain curves for Advanced Test Reactor composite, aluminum fuel plates are given for room temperature, 250 (121), 300 (149), 350 (177), 400 (204), 450 (232), and 500°F (260°C). A comparison between 6061-0 Al and the composite compressive yield strengths indicated significant strengthening affected by the core material. This effect is reflected in Young's modulus above 300°F. A description of the apparatus used, including the subpress assembly, is given. Also discussed are some problems encountered with this hardware and some probable solutions. A mechanism is discussed with respect to the strengthening by mechanical interaction of the fuel particles on the matrix. (auth)

27465 (LA-3861) REVISED DOSE ESTIMATES FOR THE CRITICALITY EXCURSION AT LOS ALAMOS SCIENTIFIC LABORATORY, MAY 21, 1946. Hankins, Dale E.; Hansen, G. E. (Los Alamos Scientific Lab., N. Mex.). Dec. 1967. Contract W-7405-eng-36. 13p. Dep. CFSTI.

Revised estimates of the dose received by personnel exposed in the Los Alamos criticality excursion that occurred May 21, 1946, are presented. The revised doses are based on a calculation of the leakage neutron spectrum from the critical system and the results obtained from a recent study of blood-sodium activation. (auth)

27466 (LA-DC-9404) REACTIVITY VALUES FROM THE LASL CROSS-SECTION TAPE LIBRARY. Mills, C. B. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 3p. (CONF-680601-12). Dep. CFSTI.

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

Effects of computer approximations on reactivity determinations are discussed. Computations of central reactivities in fast spectrum critical assemblies are tabulated as a function of neutron energy group; this shows reactivity dependence on energy. Comparison of reactivities, determined in this manner, allows neutron cross section evaluation. (M.L.S.)

27467 (ORNL-3572(Rev.2)(Vol.1A)) THE HIGH-FLUX ISOTOPE REACTOR: A FUNCTIONAL DESCRIPTION. VOLUME 1A. TEXT. Binford, F. T.; Cole, T. E.; Cramer, E. N. (eds.) (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 227p. Dep. CFSTI.

Detailed descriptive information on the High Flux Isotope Reactor (HFIR) is given under the following broad headings: Introduction; Reactor Site; Buildings; Containment, Ventilation, and Air Conditioning; Reactor and Experimental Facilities including target assembly, fuel elements, beryllium reflector, control plates, core support and assembly, reactor pressure vessel, pools, horizontal beam tubes, engineering facilities, and irradiation facilities; Cooling Systems; Core Physics, Nuclear Design, and Heat Transfer including fuel and burnable-poison loadings and distributions, fuel cycle analysis, reactivity coefficients, reactivity associated with the plutonium target, control plate nuclear characteristics, summary of reactivity accountability, summary of pertinent design data for fuel elements, fuel element mechanical and hydraulic analysis, and reactor heat transfer design; Instrumentation and Control including control plate drive mechanisms, control system, safety system, nuclear instrumentation, wide-range counting (startup) channels, process and coolant instrumentation and radioactivity monitoring; HFIR Shielding, Special Systems and Procedures, and Organization and Administration. Appendices include: HFIR Design Parameters, Manufacturers Specifications, HFIR Reports, and a Bibliography on Flux-Trap Reactors. (M.L.S.)

27468 (RCN-90) ANALYSIS OF CRITICAL EXPERIMENTS WITH B_4C CLUSTER CONTROL ELEMENTS. Boerresen, S. (Reactor Centrum Nederland, Petten). [1966]. Contract 007-61-6-PNIN. 43p. Dep.

A calculational recipe for the prediction of reactivity worth of B_4C cluster control rods is described. The method is based on effective current to flux ratios for cylindrical absorbers as described in literature. Corrections to the current to flux ratios have been obtained from transport calculations, using a computer code (MICROFLUX). The calculational recipe has been applied for the analysis of critical experiments involving B_4C cluster control elements. The agreement of the theoretical absorber worth with experiment was, for all cases investigated, within 5%. This ac-

curacy is sufficient for reactor cluster control design calculations. (auth)

27469 (SC-DR-67-801) SPR II: EARLY OPERATIONAL EXPERIENCE. O'Brien, P. D. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1967. Contract AT(29-1)-789. 14p. Dep. CFSTI.

The early operational history of the Sandia Pulsed Reactor II is summarized, and significant problems which have resulted from high-level pulsing are discussed. Two potentially serious operational problems associated with the design of the U–10% Mo fuel components are discussed in detail. One fuel ring has developed a radial crack which propagates as the number of high-level bursts increase, and airborne contamination which accompanies each burst suggests revised plating procedures are necessary. (H.D.R.)

27470 (JPRS-45100) STUDIES IN FUEL ELEMENTS AND RADIOACTIVE ISOTOPES. Translated from At. Energ. (USSR), 24: 136-43(1968). 20p. CFSTI.

Fuel burnup analysis for a PuO_2 fuel element in the BR-5 reactor is presented. High burnup efficiency is a necessity for a profitable fast reactor. Design of the fuel element and package is presented. Burnup conditions and results are also presented. Results from macrostructural and microstructural testing of fuel properties are described. Descriptions of the U.S.S.R. isotopic generators are presented. (D.C.C.)

27471 EXPERIMENTAL AND THEORETICAL DETERMINATION OF THE REACTIVITY WORTH OF ROD-TYPE ABSORBER MIXTURES IN A SUBCRITICAL ASSEMBLY. Ullrich, W.; Wiesner, S. (INTERATOM, Bensberg, Ger.). Nukleonik, 10: 315-20(Jan. 1968). (In German).

The reactivity worths of rod-type absorber mixtures, which consist of a 1/v absorber and various resonance absorbers, were measured in a slightly enriched UO_2-H_2O subcritical assembly. The measured values are compared directly with the results of a 4-group diffusion calculation; the results of this comparison are discussed with respect to the theoretical calculational model. (31 references. (M.L.S.)

27472 SOURCES OF ERROR AND INTERPRETATION OF REACTIVITY DETERMINATIONS BY MEANS OF ROD DROP AND SOURCE JERK MEASUREMENTS. Diettrich, H. O. W. (EURATOM-CCR, Ispra, Italy). Nukleonik, 10: 297-303 (Jan. 1968).

In order to interpret the results of rod drop and source jerk experiments for D_2O assemblies the influence of incorrect values of the delayed neutron data, the initial conditions and of extraneous sources on the reactivity ρ has been investigated. Within the framework of space and energy independent reactor kinetics it can be seen that the corresponding error in the reactivity varies nearly linearly with time after a reactivity or source step. An error of the total delayed neutron fraction results in a proportional and time constant error in ρ, assuming the relative values β_i/β to be correct, so that the reactivity measured in dollars is not influenced by this within the limits of the usual accuracy. The number of the photoneutron groups, having a decay constant $\lambda_i \leqq 5 \cdot 10^{-3}$ sec^{-1}, can be reduced to one without changing the results of reactivity measurements appreciably. A procedure for transforming the β_i has been given. In order to execute this program a product formulation of the solution of the kinetic equations has been used. As a by-product a time expansion series of the neutron density n(t) after a reactivity or a source step was found avoiding the roots of the inhour equation. (auth)

27473 INITIAL CONVERSION RATIO MEASUREMENTS ON AN ORGEL-TYPE CLUSTER, NATURAL URANIUM FUELED AND DIPHYL COOLED, IN D_2O LATTICES. Canalini, D.; Cecchi, P. F. (Comitato Nazionale per l'Energia Nucleare, Bologna). Nukleonik, 10: 327-9(Jan. 1968).

The initial conversion ratio, γ_0, in natural U, heavy water moderated, and diphyl cooled lattices was studied. The experiments were carried out in a 19-element metallic U Orgel-type cluster assembled in the RB-1 reactor; the following square lattice pitches were tested: 18.8 cm, 23.5 cm and 26.8 cm. The experimental data are analyzed and compared with theoretical ones obtained with the Plutharco code. (auth)

27474 APPLICATION OF THE PULSED NEUTRON TECHNIQUE TO THE CALIBRATION OF THE CONTROL RODS OF QUEEN MARY COLLEGE (DOUBLE-CORE) REACTOR. Leonidou, D. J.; Mansfield, W. K. Nucl. Energy, 53-7(Mar.-Apr. 1968).

The experimental arrangement of this critical assembly is outlined. A SAMES 150 kV accelerator was used as the pulsed neutron source, and a 1.3 cm dia BF_3 counter as detector. Graphs are plotted of the thermal neutron flux decay characteristics, and of reactivity and decay constant against percentage rod-withdrawal. (UK)

27475 FFTF WILL TEST FAST-BREEDER FUELS. Astley, E. R. (Battelle-Northwest, Richland, Wash.). Power, 112: No. 4, 79-81(Apr. 1968).

The Fast Flux Test Facility physical layout and basic design features are briefly described. The primary objective of the facility is to proof-test fuels and materials for a commercial fast breeder. Some of the unique problem areas in the safety considerations, instrumentation, fuels, and structural materials selection for the FFTF are examined. (H.D.R.)

Production Reactors

27476 NUCLEAR EQUIPMENT-MAINTENANCE STANDARDS ENHANCE REACTOR RELIABILITY. Clement, T. M. (Douglas United Nuclear, Inc., Richland, Wash.). Power, 112: No. 4, 90-2(Apr. 1968).

A system of engineered maintenance controls for the Hanford production reactors is described. The system standards were developed to insure the functional reliability of any system that affects safety, reactor life, or operating availability. The maintenance controls detail requirements for critical equipment performance, including inspection and testing frequencies; provide specific procedures for functional test, periodic calibration, inspection, disassembly, and maintenance; and provide a system of records for auditing and evaluating equipment performance. (H.D.R.)

Reactor Theory, Components, Fuels and Accessories

Refer also to abstracts 25441, 26025, 26076, 26092, 26758, 26765, and 26768.

27477 (ANL-7375, pp 178-9) ANALYTICAL RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

A method for determining fuel burnup by means of a total rare earth analysis is under development. The method is based on the precipitation of the rare earths on calcium fluoride, evaporation to dryness, anion exchange, evaporation, and titration with EDTA. A modified titration procedure is now being tested. In the development of praseodymium-141 assay as a burnup monitor, the fast fission yield of ^{141}Pr was determined by comparison to the ^{137}Cs yield. (H.D.R.)

27478 (BNL-12390) REACTOR KINETICS RESEARCH AT BROOKHAVEN NATIONAL LABORATORY. Chernick, Jack; Lellouche, Gerald; Levine, Melvin; Michael, Paul; Shotkin, Louis; Akcasu, Ziya (Brookhaven National Lab., Upton, N. Y.). Apr. 1968. 35p. (CONF-680414-2). Dep. CFSTI.

From Conference on Industrial Needs and Academic Research in Reactor Kinetics, Upton, N. Y.

A review of research work performed in the field of reactor kinetics is presented. The space-independent stability in reactors is described as a function of physical parameters such as feedback coefficients and time delays and arbitrary disturbances such as temperature, xenon and delayed neutrons. The problem of xenon induced flux oscillations is described using various models and several techniques. Also, the evaluation of the ability of detectors external to the pressure vessel of a pressurized-water reactor to give information about the power distribution inside the core is presented. 25 references are included. (D.C.C.)

27479 (BNL-50096) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 5, Number 6. (Brookhaven National Lab., Upton, N. Y.). Dec. 1967. 39p. Dep. CFSTI.

VANADIUM ALLOYS AND SYSTEMS—Ti–V, tensile properties of, effects of annealing at 900 and 1000°C on; (Ti–V), mechanical properties of, effects of surface defects on

STAINLESS STEEL—mechanical properties of type 304, effects of surface defects on; rupture of type 304 and 316, effects of 1300 to 1400°F liquid sodium on biaxial stress

REACTOR FUEL ELEMENTS—cladding of, effects of temperature and surface defects on mechanical properties of type 304 stainless steel and titanium–vanadium

FRACTURE TESTS—use for determining effects of 900 and 1000°C annealing temperature on titanium–vanadium cladding

FLOWMETERS—testing of EBR-2 1200°F liquid sodium, description of

HEATERS—electrical resistance type, description of central tantalum conductor and ceramic insulation

ALUMINUM OXIDES—electric conductivity of Al_2O_3, effects of temperature on

BERYLLIUM OXIDES—electric conductivity of BeO, effects of temperature on
ELECTRIC CONDUCTIVITY—effects of temperature on beryllium oxide (BeO) and aluminum oxide (Al_2O_3), analysis of
CARBON—detection meter for determination in liquid sodium content of, performance of (D.C.C.)

27480 (BNWL-634) REACTOR PHYSICS DEPARTMENT TECHNICAL ACTIVITIES QUARTERLY REPORT, JULY-SEPTEMBER 1967. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1968. Contract AT(45-1)-1830. 110p. Dep. CFSTI.

Brief discussions are presented for the areas of significant progress in reactor theory and code development, thermal reactor development, and fast reactor development. Separate abstracts were prepared for each of the three sections. (H.D.R.)

For abstracts of individual sections see: 27459, 27460, and 27481.

27481 (BNWL-634, pp 2.1-8) REACTOR THEORY AND CODE DEVELOPMENT. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A space-angle synthesis approximation of the transport equation has been developed which shows improved accuracy over the P1 approximation. The problem considered is an infinite homogeneous slab with a uniform source. The Battelle Revised Thermos code has been modified by the addition of an improved current calculation routine, fission cross section averaging both microscopically per isotope and macroscopically for the cell, and the capability to handle up to eight mixtures. A computer program entitled HTH, comprising an overlay of codes HRG, Battelle Revised Thermos, and HFN, has been coded to provide a code package for use in reactor analysis. Modifications have been made to the HAMMER code to make it more compatible with other codes in use at PNL. (auth)

27482 (EUR-3350) THERMAL NEUTRON SPECTRA IN UNIFORM LATTICES. USE OF CADILHAC'S FORMALISM. EURAEC Report No. 1814. Haubert, P. (Societe Belge pour l'Industrie Nucleaire, Brussels). Aug. 1967. Contract 001-64-1 TRUB. 52p. Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The use of the synthetic model of thermalization proposed by Cadilhac for the evaluation of neutron spectra in homogeneous and heterogeneous systems and more specifically in the unit cell of a uniform lattice is described. In homogeneous systems the neutron flux and the slowing-down density obey two coupled differential equations describing the conservation and the thermalization of neutrons. The neutron flux can be evaluated in different ways, for example, by transforming this set of equations into two first order differential equations, or into a Schrödinger equation or still into a Riccati equation followed by a straightforward integration. In heterogeneous systems such as the unit cell of a uniform lattice, the fine structure of the flux can very often be evaluated at each energy by monoenergetic transport or diffusion theory. For instance, the method of Amouyal and Benoist uses integral transport theory in the fuel region and adjusted diffusion theory in the moderator. This method can be generalized by the determination of the flux in the fuel element, cladding included, with the help of collision probabilities in annular systems; the use of diffusion theory in the moderator region can also be avoided. Once the fine structure has been determined, effective cross-sections can be defined and the treatment of thermalization in these systems can be done in exactly the same way as in homogeneous systems. In some cases such energy space separation is no longer possible, for instance when the unit cell has several distinct thermalizing regions. Cadilhac's model can still be used easily when the number of thermalizing regions is small, but the complexity of the computational scheme increases rapidly with the number of such regions. (auth)

27483 (EUR-3905) THESEE-1: CODE DE CALCUL DES PERFORMANCES D'UN CANAL DE REACTEUR DE TYPE ORGEL. (THESEE-1: Code for Calculating Performances of an ORGEL Reactor Channel). Chambaud, B.; Civardi, P.; Di Cola, G.; Di Cola, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center. European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center). 1968. 106p. (In French). Dep.

The code THESEE-1, programmed in language FORTRAN IV for the IBM 360 computer allows the determination of: organic coolant temperatures fine distribution of a cluster fuel element; cladding temperatures distribution around the most charged fuel rod; and average thermohydraulic performances of the channel of an ORGEL type reactor. (auth)

27484 (EURAEC-1978) STUDY ON THE RELEASE OF FISSION GASES FROM UO_2 SAMPLES IRRADIATED TO VARIOUS DOSES. Quarterly Report No. 8, July-September 1967. Baffigo, V.; Polin, F. (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari). Dec. 1967. Contract 043-65-TEEI(RD). 10p. (EUR-3777). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Results from nine diffusion experiments performed at 1400°C on UO_2 samples are presented. The decrease of apparent diffusion coefficient of Xe with increase of irradiation dose results in 2 to 3 orders of magnitude from few MWD/T to more than 1000 MWD/T. A partial recovery of this decrease is also observable from 2000 to 3000 MWD/T. (auth)

27485 (EURAEC-1998) HEAT TRANSFER INSIDE NUCLEAR FUEL CONSISTING OF COMPACTED UO_2 AND UO_2-PuO_2 POWDERS. Special Report No. 8. Andriessen, H. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Dec. 1967. Contract 001-64-1-TRUB. 39p. (EUR-3791). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The UO_2 and UO_2-PuO_2 compacted powders fuel curve $\int$ kdT was measured out-of-pile in terms of the temperature. The influence of helium, argon and nitrogen filler gases on the value $\int$ kdT was measured and the Deissler and Elan theory was used to calculate the thermal conductivity properties of the ceramic material and the gas for the total thermal conductivity values measured. The influence of the density and the presence of PuO_2 on the value $\int$ kdT were calculated. (auth)

27486 (KAPL-P-3175) THE EFFECT OF SELF-SHIELDING CORRECTIONS ON CALCULATED TEMPERATURE DISTRIBUTIONS USING VARIOUS SELF-SHIELDING SCHEMES. Anderson, W. Kermit; Hansen, Eric C.; Koenig, Edgar F.; Lechliter, Gerald L. (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 1966. Contract W-31-109-eng-52. 14p. (CONF-661001-27). Dep. CFSTI.

From 14th Conference on Remote Systems and Technology, Pittsburgh, Pa.

The computer program, MUTTR, which is a method of obtaining temperature distributions in oxide fuel rods, is described. This program establishes the fuel temperature distribution either for a constant volumetric source or for self-shielded models using any source of self-shielding information. Unpublished work by Hansen is reviewed. His results using DRAM, a general purpose Monte Carlo program, to arrive at fission distributions in a model fuel rod are drawn upon to implement the comparison of two models of self-shielding for programming MUTTR. Results compare temperature distributions in a selected annular fuel rod for the constant volumetric source, for the DRAM thermal fission distribution and for the distribution based on DRAM prediction of total fissions. (auth)

27487 (LA-3880) QUARTERLY STATUS REPORT ON THE ADVANCED PLUTONIUM FUELS PROGRAM, OCTOBER 1-DECEMBER 31, 1967. (Los Alamos Scientific Lab., N. Mex.). Feb. 20, 1968. Contract W-7405-eng-36. 55p. Dep. CFSTI.

SODIUM—fission product distribution in, from plutonium carbide-uranium carbide fuel; analysis for impurities, development of techniques for; quality control in, performance of cold traps for; corrosive effects on fuel cladding materials at 650°C
OXYGEN—solubility in sodium at 125 to 300°C; removal from sodium, performance of cold traps for; determination in germanium by helium-3 activation technique
REACTOR FUELS—preparation of ceramic plutonium; properties of ceramic plutonium, determination of high temperature; compatibility of sodium-bonded carbide and nitride, with cladding materials; radiation effects on fast, determination of neutron
PLUTONIUM CARBIDES—PuC-UC, preparation by hydrogen reduction method; PuC-UC, high temperature properties of; crystal structure of room temperature Pu_2C_3, neutron diffraction determination of; PuC-UC, compatibility of sodium-bonded, with cladding materials
PLUTONIUM NITRIDES—thermodynamic properties measurements on PuN; PuN-UN, compatibility of sodium-bonded, with cladding materials
STAINLESS STEEL—corrosion of Type 316, by sodium; analysis of carburized, for carbon by helium-3 activation technique
PLUTONIUM OXIDES PuO_2—PuO_2-UO_2, preparation and high temperature properties of
REACTOR FUEL ELEMENTS—heat transfer properties of sodium-bonded, effects of bond defects on

FISSION PRODUCTS—yields from fast neutron fission in plutonium, gamma scanning techniques for measurement of
CARBON—determination in germanium and stainless steel by helium-3 activation technique
GERMANIUM—analysis for carbon and oxygen by helium-3 activation technique
REACTORS, BREEDER—physics analysis of, evaluation of nuclear data for
NEUTRONS—effects on fast reactor fuel materials (H.D.R.)

27488 (NUMEC-3524-39) DEVELOPMENT AND TESTING OF PuO_2–UO_2 FAST REACTOR FUELS. Progress Report, April 1, 1967–June 30, 1967. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Contract AT(30-1)-3524. 19p. Dep. CFSTI.

URANIUM OXIDES UO_2, PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, porosity and density of irradiated sintered powder of, effects of organic additives on
GLUCOSE, SUCROSE, CELLULOSE, METHYL-, CARBOWAX 6000—effects on porosity and density of irradiated plutonium oxide (PuO_2)–uranium oxide (UO_2) sintered powder, analysis of
REACTOR FUELS—porosity and density control of irradiated sintered powder plutonium oxide (PuO_2)–uranium oxide (UO_2), effects of organic additives on
POROSITY—performance in plutonium oxide (PuO_2)–uranium oxide (UO_2) sintered powder fuel of burnable organic additive, analysis of
EXPERIMENTAL BREEDER REACTOR-II—irradiation of sintered powder plutonium oxide (PuO_2)–uranium oxide (UO_2) fuel with burnable organic additives in, analysis of (D.C.C.)

27489 (NUMEC-3524-47) DEVELOPMENT AND TESTING OF PuO_2–UO_2 FAST REACTOR FUELS. 11th Quarterly Report, October–December 1967. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Jan. 1968. Contract AT(30-1)-3524. 29p. Dep. CFSTI.

URANIUM OXIDES UO_2, PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, fabrication of sintered spherical pellets of, quality control using autoradiography of
REACTOR FUELS—fabrication of sintered spherical pellets of plutonium oxide (PuO_2)–uranium oxide (UO_2), quality control in using autoradiography of
AUTORADIOGRAPHY—use for quality control of plutonium oxide (PuO_2)–uranium oxide (UO_2) sintered spherical pellet fabrication by
GRAVIMETRIC ANALYSIS—equipment for plutonium oxide, calibration testing of
IRON, NICKEL, CHROMIUM, ALUMINUM, MOLYBDENUM, SILICON—abundance in coprecipitated plutonium oxide (PuO_2)–uranium oxide (UO_2) of, impurity analysis for (D.C.C.)

27490 (ORNL-4229, pp 149-55) EXPERIMENTS IN MAJOR FACILITIES. (Oak Ridge National Lab., Tenn.).

Research progress is reported on fission product behavior during in-pile melting of reactor fuels, in-pile behavior of HTGR fuel elements in steam and helium, fission products from fuels under reactor transient conditions, and behavior of fission product simulants in the Containment Research Installation (CRI) tank. (M.C.G.)

27491 (WAPD-TM-565) FRACTURE TOUGHNESS OF NON-IRRADIATED AND IRRADIATED REACTOR VESSEL STEELS. Parrish, M. L.; Seman, D. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1968. Contract NObs-90029. 92p. Dep. CFSTI.

The results of several investigations of the Wedge-Opening-Loading (WOL) fracture toughness specimen are presented. Test results are presented which demonstrate the applicability of the WOL specimen for measurement of the plane strain fracture-toughness parameter (K_{Ic}) in both nonirradiated and irradiated reactor pressure vessel steels. Some limitations of the specimen and uncertainties in validity of a portion of the resultant data are described. Fracture toughness results for various nonirradiated low-to-medium strength carbon and low-alloy steels are summarized and compared with the K_{Ic} data for A302B steel obtained in these investigations. The limited data available for SA336 (modified) and A212B steels indicate a behavior similar to that of A302B steel. (auth)

27492 CLADDING MATERIALS FOR NUCLEAR REACTOR FUELS. Kangilaski, Mihkel; Wullaert, Richard A. (Battelle Memorial Inst., Columbus, Ohio). Battelle Tech. Rev., 17: 21-7(Mar. 1968).

The development of materials capable of preventing release of fission products from nuclear fuel is described. Criteria for evaluating materials that meet this challenge in boiling-water and pressurized-water reactors are discussed, as well as some of the problems associated with devising satisfactory cladding materials for the fast-breeder reactors now being developed. Briefer reference is made to cladding materials used in nuclear reactors, such as the gas-cooled organic-cooled, molten-fuel (e.g., liquid-metal-cooled reactors), and various research and test reactors. Effects of radiation on cladding materials are explained. Both the Zircaloys and the austenitic stainless steels are now being used successfully as claddings in nuclear reactors. The trend, however, is toward Zircaloys since they provide better neutron economy and better resistance to stress-corrosion cracking, especially in BWR applications. Prime candidates as cladding materials for the LMFBR's are austenitic stainless steels and nickel alloys, mainly because of their strength at elevated temperatures and their resistance to corrosion by sodium. The relation between temperature and embrittlement in irradiated stainless steel is examined, and several mechanisms proposed to explain embrittlement by helium are considered. 16 references are included. (BBB)

27493 ENERGY-DEPENDENT BOLTZMANN EQUATION AND THE CRITICALITY PROBLEM FOR A SLAB REACTOR. Theophilou, Andreas (Democritus Nuclear Research Center, Athens). Nukleonik, 10: 292-7(Jan. 1968).

The energy-dependent isotropic Boltzmann equation is treated. The scattering operator is expanded in terms of degenerate kernels in order to obtain the solutions in a simple form. The method developed is applied for solving the criticality problem for a slab reactor. The effect of the energy dependence of the total cross section to the uniqueness of the solution is investigated. The solutions obtained are suitable for numerical calculations. (auth)

27494 COMPACTIBILITY OF GRAPHITE POWDER FOR HIGH TEMPERATURE REACTOR FUELS. Oikawa, Takashi (Central Research Lab., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 5: 168-78(Apr. 1968).

The compactibility of three kinds of graphite powder is investigated and found to be good except in the case of artificial graphite. The compactibility is found impaired by purification of the powder but restored completely or even improved above the original value by thorough ball milling. The porosity V of the compacts is related to the compaction pressure P by the function $\log V = A - B \log P$, where A and B are constants. The cause of these changes observed in compactibility is investigated and attributed to the shape of the powder particles. The graphite particles acquired complex shapes during the purification. The high temperatures to which the powder is exposed and purified caused recrystallization through the action of free carbon particles precipitated from the thermodecomposition of freon gas (CCl_2F_2) used for purification. These complex shaped particles disintegrated again into thin flaky particles by thorough milling. (auth)

27495 INTEGRAL EQUATION ARISING IN THE THEORY OF NEUTRON STREAMING. Williams, M. M. R. (Queen Mary Coll., London). Proc. Cambridge Phil. Soc., 64: 447-53(Apr. 1968).

A singular integral equation, arising in the theory of neutron streaming in cylindrical channels, can be solved by the Wiener–Hopf technique. The singular equation is converted into a non-singular Fredholm equation, which may be solved very simply by finite difference methods and matrix inversion. An exact expression is obtained for the neutron density as a function of distance from the channel wall, and this is compared with an approximate solution obtained earlier using a variational technique. The connection between this problem and the conventional Milne problem of radiative transfer is elucidated, and the angular distributions of emergent particles are compared for the two cases. (auth) (UK)

27496 REACTOR CALCULATIONS USING TRANSMISSION- AND REFLECTION-MATRICES. Nuding, Erich. Nukleonik, 10: 303-15(Jan. 1968). (In German).

Iterative calculational techniques, for treating transmission and reflection matrices on directed neutron beams, are formulated. The method is applied to the inhomogeneous boundary value problem and reactor criticality calculations. In the inhomogeneous problem the neutron beam term can be readily obtained; this allows determination of the critical parameters. (49 references.) (M.L.S.)

27497 EXAMINATION OF IRRADIATED NUCLEAR FUELS. II. Lambert, J. D. B. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Energy, 34-45(Mar.-Apr. 1968).

Methods for the optical examination of thin sections of nuclear fuel are discussed. Examples of studies made in a remote metallographic suite include recoil damage in UO_2–Fe cermets, structural changes in $(U,Pu)O_2$ fuel pins, microstructural changes in vibro-compacted fuel, failure of a UO_2–stainless steel cermet plate due to sigma formation, and swelling of (U,Pu)C caused by

slumping of the free metal phase. The application of replica electron micrography to both irradiated UO_2 and UC is discussed. Techniques of α and β/γ auto-radiography are described which record and distinguish between the α particles emitted by Pu and the β and γ from fission products. The use of precision γ-scanning to plot fission product distribution is discussed. (UK)

27498 MODEL INVESTIGATION FOR THE DETERMINATION OF THE STRESS STATE IN A REACTOR SAFETY VESSEL. May, B. (Technische Hochschule, Hanover). pp 203-34 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

A model study was made of the stress state in a reactor safety vessel of circular cylindrical shape. A detailed description is given of the model used, the experimental techniques, and the measurement devices. The results obtained are valid for a charge composed of longitudinal and ring stress. (J.S.R.)

27499 EXPERIENCES IN THE PRE-TESTING AND ACCEPTANCE OF STEEL SAFETY VESSELS AND PRESSURE VESSELS. Morgner (Technischer Ueberwachungs-Verein Rheinland, eV, Cologne). pp 143-54 of Probleme des Bautechnischen Strahlenschutzes. II. Schultz, H.; Bagge, E.; Boehnecke, G. (eds.). Munich, Verlag Karl Thiemig KG, 1967. (In German).

From Conference on Radiation Protection, Hanover. See CONF-661060.

The design and calculation of steel safety vessels and pressure vessels are described. The pre-acceptance material and weld seam tests, pressure tests, and tightness tests are discussed. (J.S.R.)

27500 NEUTRONICS. Le Moigne, M. L. pp 143-324 of Genie Atomique. Tome I. Cours Fondamental. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1967. (In French).

The properties of the free neutron are given, and the characteristics of the scattering of thermal neutrons are outlined. The basic slowing down process is individual elastic collision, which is studied. Some magnitudes permitting the description of the slowing down of a neutron population are then defined and calculated. Source terms are introduced in the neutron balance and consequences of finite dimensions of the medium by the introduction of leak terms are examined. The equations for the description of the heterogeneous reactor and reactor dynamics are derived. The evolution of the reactivity in a reactor in operation is given. (J.S.R.)

27501 THERMICS. Marchal, M. R. pp 325-432 of Genie Atomique. Tome I. Cours Fondamental. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1967. (In French).

The equations describing heat transmission by radiation, conduction, and convection are derived and discussed. The heat transfer between the fuel element and the heat carrier is studied. It is assumed in the study that there is no change of state. Cooling by boiling is then considered. The characteristics of various heat transfer cycles are given. (J.S.R.)

27502 THERMODYNAMICAL ASPECTS OF NEUTRON THERMALIZATION THEORY. Grmela, M. (Nuclear Research Inst., Rez, Czechoslovakia). Kernenergie, 11: 33-9(Feb. 1968).

For the case of the neutron thermalization process the following problems are solved: derivation on non-equilibrium thermodynamic laws describing this process from microscopic neutron thermalization theory; optimal choice of macroscopic characteristics; and range of validity of minimum entropy production principle. (auth)

27503 STREAMING OF NEUTRONS THROUGH CYLINDRICAL AND FLAT NEUTRON GUIDES. Broder, D. L.; Kozlovskii, S. A.; Kyz'yurov, V. S.; Levin, V. V.; Matalov, I. E.; Popkov, K. K.; Smetanin, A. A.; Shipilov, A. E. (Fiziko-Energeticheskii Institut, Obninsk, USSR). Kernenergie, 11: 48-53(Feb. 1968). (In Russian).

Starting from the one-group diffusion approximation, relations have been derived describing the neutron transport through cylindrical and flat neutron guides. Streaming of neutrons through channels of Al, Fe, and Pb, being placed in water or in boron carbide, has been studied experimentally. The core of a water-water reactor and a source of 4 MeV monoenergetic neutrons were used as the neutron sources. The neutron flux was measured by activation foils and a BF_3 counter. The results are discussed and utilized for determining the parameters of the formulae derived above. (auth)

27504 ABSOLUTE REACTIVITY MEASUREMENTS AND OTHER PARAMETERS. EXPERIMENTAL DETERMINATION WITH METHOD OF STATISTICAL WEIGHTS. Mogil'ner, A. I.; Osipov, V. A.; Fokin, G. N. At. Energ. (USSR), 24: 42-5(Jan. 1968). (In Russian).

The results of the use of the theorem on the complete statistical weights of reactor materials for measurement of some of its absolute characteristics are reported. The methodics of the measurement of the complete statistical weights are explained. The results of the measurement of the parameter K^+, subcriticality, efficiency of the regulator, and effective yield of delayed neutrons are reported. The conservatism of K^+ and its satisfactory approximation of the parameter K_∞ were confirmed experimentally. All the experimental results obtained agree well both with the results obtained by use of the statistical method and with the calculated data. (tr-auth)

27505 ONE-GROUP CALCULATIONS OF THE INTERACTION IN FUEL SYSTEMS TAKING INTO ACCOUNT MULTI-GROUP EFFECTS. Heinrich, H. (VEB Kernkraftwerksbau, Berlin). Kernenergie, 11: 39-43(Feb. 1968). (In German).

Multigroup calculations for systems of identical fuel units interacting through air and, perhaps, having a common outer reflector can exactly be replaced by one-group calculations when using effective values of the surface multiplication of the fuel units and the reflector. Rules for the calculation of these values are derived. (auth)

27506 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Ford, Lionel Houston; Ingleby, Bryan Edward; Hibbert, Neil Silva (to United Kingdom Atomic Energy Authority). British Patent 1,107,708. Mar. 27, 1968. Filed Dec. 31, 1963.

A method for producing high integrity spheroids of UC fuel is presented. The method consists of exposing spheroids of UC to pyrolytic carbon at 1200 to 1400°C. A thin layer of carbon is deposited on the spheroid without chemical interaction. A SiC coating is applied at 1200 to 1400°C, and then another coating is applied at 1500 to 1800°C. A voidage is therefore formed between the coated UC spheroid and the SiC coating. (D.C.C.)

27507 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Ford, Lionel Houston; Ingleby, Bryan; Hibbert, Neil Silva (to United Kingdom Atomic Energy Authority). British Patent 1,107,709. Mar. 27, 1968. Filed Mar. 19, 1964.

A method for producing UC_2 fuel is presented. The method consists of mixing UO_2 with a binder and with slightly excess stoichiometry of carbon to produce UC. Mixing the granulated spheroids of UC with a fluidized bed of pyrolytic carbon at 1500°C produces UC_2. (D.C.C.)

27508 PERIOD MEASURING DEVICE. Inomo, Yoshimitsu (to Matsushita Electric Industries Co., Ltd.). Japanese Patent 1967-8280. Apr. 7, 1967. Filed Oct. 23, 1964.

By the method proposed, the time for which the output of the comparison device is short-circuited, according to the change in the period output, can be controlled, and depending on the purpose, it is used, thus leading to the more safety. The period output is applied to the comparison device and to the differentiating device. When the output of the former device appears, the output itself is short-circuited by the amount of time which is inversely proportional to the output of the differentiating device. (NSA of Japan)

27509 PERIOD MEASURING DEVICE. Inomo, Yoshimitsu (to Matsushita Electric Industries Co., Ltd.). Japanese Patent 1967-8279. Apr. 7, 1967. Filed Oct. 23, 1964.

By the method proposed, the cost of reactor operation can be reduced, thus being more promising for industrial applications. The power output, obtained by logarithmic amplification and differentiation, is level-set in a comparison circuit. Power outputs both delayed and nondelayed are applied to an AND circuit. After a specified time, when the differentiated power output has exceeded the set value, a scram signal is issued. (NSA of Japan)

27510 NUCLEAR REACTOR XENON POISONING VARIATIONS COMPENSATION. Maldague, P.; de Waegh, F. A. (to Societe Anglo-Belge Vulcain Societe Anonyme). Canadian Patent 776,218. Jan. 16, 1968. Priority date Feb. 13, 1962, Belgium.

The ratio of light to heavy water flowing through the core is changed in response to reactivity variations. Also, the concentration of a boron-containing solution is modified in response to the water temperature so as to maintain the combined effect upon reactivity of ^{135}Xe and the boron solution. The solution concentration is adjusted so that it is substantially equal to the ^{135}Xe equilibrium poisoning at full power. Provision is made for a deviation of flow from the primary fluid through a separate circuit in which

the removal of the boron compound is achieved by distillation. (F.S.A.)

27511 RADIATION SHIELDING MATERIALS. Richter, Heinz Alois; Blackbourn, Michael (to English Electric Co., Ltd.). British Patent 1,105,957. Mar. 13, 1968. Filed Nov. 27, 1964.

A description of a nuclear radiation shield is presented. The shield consists of loose unbonded dry filling material of a density greater than 1900 kg/m^3. The shielding material consists of a gamma-suppressing substance such as: barytes, magnetite, ilmenite, hematite, metallic lead, and metallic iron. Mixed with the shielding substance is also a material such as: borocalcite, colemanite, boron carbide, and calcium metaborate. (D.C.C.)

27512 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF NUCLEAR FUEL. Huddle, Roy Alfred Ulfketel; Horsley, Geoffrey Winton (to United Kingdom Atomic Energy Authority). British Patent 1,110,795. Apr. 24, 1968. Filed July 29, 1964.

A method for fabricating spherical fuel particles having a carbon content in excess of the stoichiometric ratio is described. Enriched UO_2 powder is mixed with carbon and a polymerisable binder of furfuryl alcohol and then heated to reduce the oxide. The formed spherical pellets are hardened by polymerising the binder and then heated and coated with pyrolytic carbon. (D.C.C.)

27513 GENIE ATOMIQUE. TOME I. COURS FONDAMENTAL. (Atomic Engineering. Volume I. Fundamental Course). Bibliotheque des Sciences et Techniques Nucleaires. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1967. 451p.

Fundamental nuclear and thermodynamic principles applicable to the operation of nuclear reactors are reviewed. Three sections are included on the basic physics of fission reactions and radioactivity, neutronics characteristics of reactors, and heat transfer principles and cycles. Separate abstracts were prepared for each of the 3 sections. (H.D.R.)

For abstracts of individual sections see: 27393, 27500, and 27501.

GENERAL

Refer also to abstract 25886.

27514 (BNWL-SA-1546) PROBLEMS OF WATER POLLUTION ASSOCIATED WITH THERMAL ENERGY INDUSTRIES. Foster, R. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 7, 1967. Contract AT(45-1)-1830. 8p. (CONF-671213-1). Dep. CFSTI.

From 3rd Annual Meeting of the Columbia Plateau Resources Council, Spokane, Wash.

A review is presented of the problems of water pollution associated with thermal energy industries. Predictions are made of the quantities of electric power which will be produced by thermal generators as compared with hydroelectric generators in the next ten and twenty years, and of the cooling requirements for the thermal power plants. The comparative costs of using rivers, ponds, oceans, or cooling towers for heat dissipation from thermal power plants are discussed, and the effects of this cooling on other uses of water, particularly for the maintenance of aquatic life, are analyzed. A careful, unemotional evaluation of the relative benefits and costs of using any body of water for cooling power plants is urged. (L.C.L.)

27515 (COO-1182-24) VAPORIZATION AND THERMODYNAMICS OF THE PRASEODYMIUM AND GADOLINIUM SULFIDES Pr_3S_4 AND GdS. Fries, James A.; Cater, E. David (Iowa Univ., Iowa City. Dept. of Chemistry). Apr. 3, 1968. Contract AT(11-1)-1182. 33p. Dep. CFSTI.

The sulfides of praseodymium and gadolinium, Pr_3S_4 and GdS, were synthesized by reaction of the elements followed by annealing at high temperatures in vacuum. The congruent vaporization of Pr_3S_4 was studied mass spectrometrically over the temperature range 1950 to 2104°K, and the data combined with earlier vacuum balance studies. The gaseous species identified were PrS, Pr, and S. Neither Pr_3S_4 nor PrS_2 molecules were observed. Partial pressures of the observed species PrS and Pr were calculated by assuming a sensitivity constant ratio for PrS to Pr of 1.5 and the partial pressure of sulfur was then calculated from stoichiometric requirements. The partial pressures were treated by second law methods to obtain thermodynamic values. The heat of formation of solid Pr_3S_4 compares well with a value for Ce_3S_4. Preliminary treatment of the mass spectrometric data for the sublimation of GdS gives a value for the dissociation energy of $GdS_{(g)}$ of $\Delta H^{\circ}_{1175°K} = 134.0 \pm 7.0$ kcal/mole. (auth)

27516 (LA-DC-7920) "TWINKLE-BOX" ANALOG DISPLAY UNIT. Rogers, Paul C. (Los Alamos Scientific Lab., N. Mex.). July 28, 1965. Contract W-7405-eng-36. 8p. Dep. CFSTI.

A simple analog display unit or "Twinkle-Box" has been built for use with bipolar or monopolar pulses of amplitudes between 0.2 and 10.0V. Two separate pulses are stretched so as to have decay time-constants of 10 ms. A spot on the CRT screen is then intensified at X and Y coordinates corresponding to the amplitudes of the original pulses. The intensification time is variable between 2 and 20 μs. This display unit may be operated in one of four logical modes, X only, Y only, Internal and External. (auth)

27517 (MIT-1965-63) THERMODYNAMIC, SPECTRAL, AND STRUCTURAL STUDIES OF COMPLEX IONS. Annual Report, September 15, 1967-September 14, 1968. (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). Apr. 12, 1968. Contract AT(30-1)-1965. 24p. Dep. CFSTI.

Topics covered include: structural studies of some key ruthenium cluster compounds, infrared spectra of metal atom cluster halides, molybdenum cluster complexes from molybdenum acetate, stretching frequencies of quadrupole metal-metal bonds, preparation and spectroscopic study of substituted $Re_2(O_2CC_6H_5)_4X_2$ and $Mo_2(O_2CC_6H_5)_4$ compounds, structural characterization of $Ru_2(O_2CC_3H_7)_4Cl$, studies of trimeric β-ketoenol-type compounds, and the structure of $(Ph_2PCH_2CH_2PPh_2)Cr(CO)_4$. (M.C.G.)

27518 (NASA-SP-5047) TELEOPERATORS AND HUMAN AUGMENTATION. An AEC-NASA Technology Survey. Johnsen, Edwin G.; Corliss, William R. (Atomic Energy Commission, Washington, D. C. National Aeronautics and Space Adminstration, Washington, D. C.). Dec. 1967. 273p. GPO $1.00.

General purpose, dexterous, cybernetic machines developed in the past 25 years are described. Such machines, known as teleoperators, can both extend and amplify human beings' capabilities. These machines may be used in nuclear and space work, for exploring the seas, increasing industry's productivity, manipulating materials in hazardous environments safely, and aiding physically handicapped persons. Recent developments and trends in the development of principal subsystems of contemporary teleoperators are emphasized. (R.C.K.)

27519 (NLCO-1012) EFFECT OF ACID CONCENTRATION AND OTHER FACTORS ON THE DETERMINATION OF SILICON IN MAGNESIUM. Brueneman, A. L.; Prall, J. R. (National Lead Co. of Ohio, Cincinnati). Apr. 1968. Contract AT(30-1)-1156. 7p. Dep. CFSTI.

Several analytical methods for the determination of silicon in magnesium were investigated and found to yield low results. Mass spectrometric analysis of the evolved gases indicated that the low results were due to the loss of silicon as silicane (SiH_4). Variables investigated were: methods of dissolution, acid concentration, and reaction time. A photometric, molybdenum blue method using concentrated nitric acid to dissolve the magnesium is presented. (auth)

27520 (ORNL-3300(Vol.7)) PUBLICATIONS, REPORTS, AND PAPERS FOR 1967 FROM OAK RIDGE NATIONAL LABORATORY. O'Hara, F. M. Jr.; Klein, Ann S. (eds.) (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 326p. Dep. CFSTI.

A bibliography of publications, reports, and papers developed at Oak Ridge National Laboratory during 1967 is presented. A keyword and an author index are included. (B.G.D.)

27521 (ORNL-4236) MATHEMATICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1967. Feliciano, Manuel Jr. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Apr. 1968. Contract W-7405-eng-26. 110p. Dep. CFSTI.

MATRICES (MATHEMATICS)—solutions to single nonlinear equations with clustered roots using, relation of bigradients to Hankel determinants for; characterization of n-th order symmetric involutory; solutions to vector-valued random-difference equations using; convergence characteristics of identically distributed random, definition of

ALGORITHMS—convergence of, determination of truncated error bounds with linear

FOURIER TRANSFORMS—data-distortion description by, determination of experimental error from

GRAPHITE—stress analysis of in-pile, use of nonhomogeneous biharmonic code for viscoelastic

REACTORS—economics of, mathematical model for

DIFFERENTIAL EQUATIONS—use in model of steady-state distribution of steam pressure steam-graphite reaction; enzymic-substrate interaction description using linear

REACTOR FUELS—reprocessing plants for, mathematical model for optimization of

PLUTONIUM—excretion of, body burden determination using data on

COMPUTER PROGRAMS—for neutron physics research at ORNL, summary of development of; PLUME, for estimation of radiation doses following a reactor accident; execution of ORNL, optimization of; subroutines for ORNL library of; compilation of special; ORNL FORTRAN, for conversion of FORTRAN 63 programs for use on IBM 360/75

GOLD, GERMANIUM—Moessbauer studies on, computer programs for

FISSION PRODUCTS—deposition of, computer program for finite difference solution to coupled integral equations for; deposition from molten fuel element mockup, mathematical model for analysis of data from

REACTORS, POWER—piping for, computer program for determination of stresses in elbows for

FUSED SALTS—thermodynamic properties of binary mixtures of, determination of composition dependence of

ORNL HIGH-FLUX ISOTOPE REACTOR—neutron spectrometers for, computer control of triple-axis

COMPUTERS—operation of ORNL IBM 360/75; maintenance of ORNL IBM 360/75, computer routines for; IBM System/360, complete listing and description of; IBM 360/75, productive time and downtime for ORNL; CDC 1604-A, productive time and downtime for ORNL

STATISTICS—selection for response surface designs, using, method for; probability estimates using, effects of mixtures of distributions on; bivariate distributions, definition of properties of; random variables, nonparametric tests of independence between successive elements in sequence of; nonnull distribution, definition of uniform convergence to noncentral chi-square distribution of; noncentral chi-square distributions; minimum-average-risk decision procedures for noncentrality parameters for; information in Borel sub-

field, use of probability measures to define; normal populations with unknown variances, nonnull distribution method for making inferences about difference between means of two; probability distributions involving Stirling numbers of second kind, discrete random variable form of; use in human cytogenetics, summary of
EVOLUTION—statistical model for, matrix definition of
STOCHASTIC METHODS—random variable representation using, regression equations for; probability distributions in riff shuffle using, determination of discrete; differences of zero using random sampling, determination of Stirling numbers of second kind and table of
RADIATION DOSE—response of biological systems to, probability estimates for parameters for
TOPOLOGY—equivalence of letter classes using, determination of fractional factorial design
MAMMALIA—recovery of, statistical application to
MICE—radioinduced lens opacity in, exponential models for determining RBE for
INSECTA—drosophila, nonrandom disjunction in
GENETICS—mutation frequencies and survival data on fungal, mathematical models for
MUTATIONS—mathematical model for neurospora
TUNGSTEN—deposition of, statistical model of vapor; deposition of, effects of temperature on vapor
TUNGSTEN FLUORIDES—tungsten deposition from, flow rate effects on efficiency for
CHIMERAS—mixing index for, statistical model for
NEUTRON SPECTROMETERS—control of HFIR triple-axis, use of PDP-8 computer for

27522 (SC-CR-67-2855) ORGANIC ELECTROLYTE BATTERY. McDonald, Guy D.; Murphy, Karen M.; Gower, Judith L. (Globe-Union, Inc., Milwaukee, Wis.). Dec. 1967. Contract 58-0690. 69p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

Efforts were concentrated on developing electrolytes for an organic electrolyte battery operable between −54 and 121°C. Thirty-one solvents chosen according to liquid range, viscosity, density, and functional group were screened on the basis of minimum conductivity using lithium perchlorate or phenyltrimethylammonium hexafluorophosphate. The eleven solvents passing the screening test were vacuum distilled and characterized by gas chromatography or Karl Fisher titration. The conductivity, viscosity, and density of each solution were measured over the temperature range −54 to 121°C. All the solutes were dried and characterized by x-ray diffraction, thermal analysis, and Karl Fisher titration. In addition, on the basis of specific energy calculations and stability tests, anodes of calcium and magnesium were selected to be investigated by linear sweep voltammetry. The potential of a newly developed nonaqueous reference electrode was found to be temperature dependent. A correction factor was determined for use at each temperature. (auth)

27523 (SC-DC-68-2132) RECOVERY OF A PHOTOGRAPHIC FERRICYANIDE BLEACH. Hunter II, Waldo S. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1968. Contract AT(29-1)-789. 8p. Dep. CFSTI.

The three common methods used to maintain the bleach at its required strength include: addition of concentrated replenisher, rejuvenation with persulfate and bromide, and bromination. The system using bromine is described. A sample of bleach is analyzed for ferrocyanide, the bromine necessary to rejuvenate the system back to a ferrocyanide concentration of 2 g/l is added with the system turned on and flowing to all of the machine bleach tanks, and after about 4 hr another ferrocyanide determination is made. Bromine is inexpensive and the recovery cell does not interrupt production. (M.C.G.)

27524 (TID-24358) TESTS OF THE DEAERATOR AT THE FREEPORT SEAWATER DESALTING PLANT AND EVALUATION OF DISSOLVED GAS ANALYSIS. Research and Development Progress Report No. 310. Hammond, R. P. (Oak Ridge National Lab., Tenn.); Hunter, J. A.; Sieder, Everett N.; Tomalin, Paul G. (Office of Saline Water, Washington, D. C.). Nov. 1967. 44p. Dep. CFSTI. GPO $0.35.

Two series of tests were made on the Freeport deaerator to determine its performance. The Freeport deaerator is a packed tower which uses countercurrent steam flow for stripping dissolved gases. Test runs were made with various degrees of flash-down, different steam rates, condensing of steam, different spray patterns, and liquid rates of 10,600 and 17,000 lb/hr · ft^2. The results showed that the oxygen could be reduced to 10 ppB and that the carbon dioxide could be reduced to 3 ppM. Inadequate acid mixing or insufficient residence time may be responsible for failure to achieve the desired carbon dioxide level of 1 ppM. A survey was made to find gas analyzers for detecting low levels of oxygen and carbon dioxide. Evaluation of an oxygen analyzer previously evaluated at several seawater sites indicated that it has a potential for measuring the low oxygen levels, but further work is required to check the validity of the calibrator on seawater. The calibration of this instrument by comparative analyses with the Potter-White chemical method appeared to be successful in the range of oxygen (54 to 142 ppB) at Freeport. The ASTM method for carbon dioxide analyses yielded reasonable results. The procedure in the ASTM method was modified slightly to reduce the required testing time from one hour to forty minutes. (auth)

27525 (K-Trans-31) ON THE INFLUENCE OF THE MACH NUMBER AND THE REYNOLDS NUMBER ON THE AERODYNAMIC COEFFICIENTS OF COMPRESSOR CASCADES WITH DIFFERENT FLOW TURBULENCES. Hebbel, Hans-Hermann. Translated for Oak Ridge National Lab., Tenn., from Forsch. Ingieurw., 33: No. 5, 141-50(1967). 32p. Dep. CFSTI. JCL $3.60 fs, $1.16 mf.

In jet-propelled machines, a considerable loss of efficiency frequently occurs at very high altitudes because of the small Reynolds numbers as a result of a laminar separation of flow on the blade surface. This drop in efficiency, however, can be avoided in part by increasing the flow turbulence. For this purpose, the degree of turbulence is increased in the inlet, on one hand, and on the other hand, turbulence generators (turbulence wire, roughness) were provided on the leading edge. Measurements were performed in the high-velocity cascade wind tunnel in which the inlet Mach number ($Ma_1 = 0.3$ to 0.9) and the inlet Reynolds number ($Re_1 = 5 \times 10^4$ to 4×10^5) were varied independently. The investigations included measurements of the wake and pressure distribution with two compressor cascades of slightly cambered profiles of the NACA-Series 65. It was found that an artificial increase of turbulence at small Reynolds numbers ($Re_1 < 10^5$) results in a considerable decrease of the loss coefficient as well as in an increase of the deflection and pressure conversion of the two cascades. (auth)

27526 SOIL-PLANT SYSTEM IN RELATION TO INORGANIC NUTRITION. Fried, Maurice; Broeshart, Hans. American Institute of Biological Sciences and U. S. Atomic Energy Commission Monograph Series on Radiation Biology. New York, Academic Press, 1967. 358p. $5.00.

Fundamental aspects of soil systems and the movement of ions from the soil into soil solutions and hence into plant roots and plant shoots are reviewed. Physical and chemical factors that affect the supply of nutrients to plants grown in the soil, methods for the measurement of soil nutrient supply, and the principles of fertilizer application are discussed. (1062 references) (C.H.)

27527 SPACE SYSTEMS TECHNOLOGY. Heitchue, Regis D. Jr. (ed.) New York, Reinhold Book Corporation, 1968. 309p. $15.00.

Several basic sub-systems which are the most frequently encountered in space systems for a wide variety of missions are discussed with major emphasis placed on physical fundamentals rather than on present technology. The systems examined are propulsion, electrical power, flight control, structures, communications, crew, and life support. Applications of nuclear reactors for rocket propulsion and the use of reactors and radioisotopes in electrical power supply systems are briefly reviewed. (H.D.R.)

Appendix I

JOURNAL LIST

The following list includes 1968 additions to the comprehensive list published in NSA, Volume 22, No. 1, January 15, 1968. In the future, comprehensive lists will be published once each year (in January), and current additions will be cumulated on a monthly basis (in alternate issues) until the next comprehensive list is issued.

The title abbreviations are based on the United States of America Standards Institute's REVISED AND ENLARGED WORD-ABBREVIATION LIST FOR USASI Z39.5–1963 AMERICAN STANDARD FOR PERIODICAL TITLE ABBREVIATIONS. Titles of journals that are scanned regularly for NUCLEAR SCIENCE ABSTRACTS are marked by an asterisk (*). Foreign-language journals identified by a dagger (†) are available in English translation. The original-language title for a translated journal is given in parenthesis after the English title.

Acta Anat. Nippon.
Acta Anatomica Nipponica
see **Kaibogaku Zasshi**

Acta Astron.
Acta Astronomica, Polska Akademia Nauk (formed by merger of Acta Astronomica, Ser. A; Ser. B; and Ser. C) *(Poland)*

Acta Entomol. Bohemoslov.
Acta Entomologica Bohemoslovaca *(Czechoslovakia)*

Acta Geod., Geophys. Montanistica
Acta Geodaetica, Geophysica et Montanistica *(Hungary)*

Acta Med. Iugoslav.
Acta Medica Iugoslavica *(Yugoslavia)*

Acta Pharm. Hung.
Acta Pharmaceutica Hungarica *(Hungary)*

Acta Pharm. Suec.
Acta Pharmaceutica Suecica *(Sweden)*

Acta Phys. Chem.
*Acta Physica et Chemica *(Hungary)*

Acta Polytech., Chem. Met. Ser.
Acta Polytechnica, Chemistry including Metallurgy Series *(Sweden)*

Acta Sci. Natur. Univ. Pekin.
Acta Scientiarum Naturalium Universitatis Pekinensis
see **Pei Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh**

Acta Univ. Nankinensis Sci. Natur.
Acta Universitatis Nankinensis Scientiarum Naturalium
see **Nan Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh**

Acta Univ. Upsaliensis, Abstr. Uppsala Diss. Sci.
Acta Universitatis Upsaliensis, Abstracts of Uppsala Dissertations in Science *(Sweden)*

Advan. Contr. Syst.
Advances in Control Systems *(U. S.)*

Advan. Cryog. Eng.
Advances in Cryogenic Engineering *(U. S.)*

Advan. Nucl. Phys.
Advances in Nuclear Physics *(U. S.)*

Advan. Polym. Sci.
Advances in Polymer Science
see **Fortschr. Hochpolym.-Forsch.**

Advan. X-Ray Anal.
Advances in X-Ray Analysis *(U. S.)*

Aesthet. Med.
Aesthetische Medizin *(West Germany)*

Agr. Hokkaido
Agriculture in Hokkaido
see **Hokuno**

Agr. Res. (New Delhi)
Agricultural Research (New Delhi) *(India)*

Air Clean.
Air Cleaning
see **Kuki Seijo**

Air Water Pollut.
*Air and Water Pollution (formerly International Journal of Air Water Pollution) *(U. S.–England)*

Ala. J. Med. Sci.
Alabama Journal of Medical Sciences, The *(U. S.)*

Alloy Dig. Zr-3
Alloy Digest Zr-3 *(U.S.)*

Amer. Mach./Metalwork. Mfg.
American Machinist/Metalworking Manufacturing *(U. S.)*

Anal. Lett.
Analytical Letters *(U. S.)*

Ann. Acad. Sci. Fenn., Ser. A IV
Annales Academiae Scientiarum Fennicae, Series A IV *(Finland)*

Ann. Bot. Fenn.
Annales Botanici Fennici *(Finland)*

Ann. Dent.
Annals of Dentistry *(U. S.)*

Ann. Ponts Chaussees
Annales des Ponts et Chaussees *(France)*

Annu. ISA (Instrum. Soc. Amer.) Conf. Proc.
Annual ISA (Instrument Society of America) Conference Proceedings *(U. S.)*

Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. DD
*Annales Universitatis Mariae Curie-Sklodowska, Lublin-Polonia, Sectio DD *(Poland)*

Ann. Univ. Sci. Budapest. Rolando Eotvos Nominatae, Sect. Geol.
*Annales Universitatis Scientiarum Budapestinensis de Rolando Eotvos Nominatae, Sectio Geologica *(Hungary)*

Annu. Rep. Res. Inst. Environ. Med., Nagoya Univ.
Annual Report of the Research Institute of Environmental Medicine, Nagoya University *(Japan)*

Annu. Rev. Genet.
Annual Review of Genetics *(U.S.)*

An. Univ. Bucuresti, Ser. Stiint. Natur., Fiz.
Analele Universitatii Bucuresti, Seria Stiintele Naturii, Fizica *(Romania)*

Arbeitsgemeinsch. Forsch. Landes Nordrhein-Westfalen
Arbeitsgemeinschaft fuer Forschung des Landes Nordrhein-Westfalen *(West Germany)*

Arbeitsmed.-Sozialmed.-Arbeitshyg.
Arbeitsmedizin-Sozialmedizin-Arbeitshygiene *(West Germany)*

Arch. Jap. Chir.
Archiv fuer Japanische Chirurgie
see **Nippon Geka Hokan**

Arch. Mineral.
Archiwum Mineralogiczne *(Poland)*

Arch. Neer. Sci. Exactes Natur.
Archives Neerlandaises des Sciences Exactes et Naturelles *(Netherlands)*

Arch. Stomatol.
Archivio Stomatologico *(Italy)*

Ark. Zool.
Arkiv for Zoologi, Utgivet av Kungl. Svenska Vetenskapsakademien *(Sweden)*

ASM (Amer. Soc. Metals), Trans. Quart.
*ASM (American Society for Metals), Transactions Quarterly (formerly Transactions of the American Society for Metals) *(U. S.)*

Astrofizika
Astrofizika *(Armenian S.S.R.)*

Astron. Tsirk.
Astronomicheskii Tsirkulyar *(U.S.S.R.)*

Astrophys. Lett.
*Astrophysical Letters *(Scotland)*
Astrophys. Space Sci.
*Astrophysics and Space Science *(Netherlands)*
At. Absorption Newslett.
Atomic Absorption Newsletter *(U. S.)*
At. Energy (China)
Atomic Energy (China)
see Yuan Tzu Neng
At. Energy Law J.
Atomic Energy Law Journal *(U. S.)*
Atmos. Environ.
*Atmospheric Environment *(England)*
Aust. J. Mar. Freshwater Res.
Australian Journal of Marine and Freshwater Research *(Australia)*
Aust. J. Zool.
Australian Journal of Zoology *(Australia)*
Aust. Mach. Prod. Eng.
Australian Machinery and Production Engineering *(Australia)*
Australas. Mfr.
Australasian Manufacturer *(Australia)*
Automat. Electron.
Automatica si Electronica *(Romania)*
Bautechnik
Bautechnik, Die *(West Germany)*
Ber. Deut. Ges. Geol. Wiss., Reihe B
Berichte der Deutschen Gesellschaft fuer Geologische Wissenschaften, Reihe B. Mineralogie und Lagerstaettenforschung *(East Germany)*
Berg- Huettenmaenn. Monatsh. Montan. Hochsch. Leoben
Berg- und Huettenmaennische Monatschefte der Montanistischen Hochschule in Leoben *(West Germany)*
Berlin. Wetterkarte, Suppl.
Berliner Wetterkarte, Supplement *(West Germany)*
Beton Zhelezobeton
Beton i Zhelezobeton *(Georgian S.S.R.)*
Biol. Rundsch.
Biologische Rundschau *(East Germany)*
Blech
Blech *(West Germany)*
BNX Rev.
BNX Review *(England)*
Bodenkultur
Bodenkultur, Die *(Austria)*
Boll. Zool.
Bollettino di Zoologia. Pubblicato dall'Unione Zoologica Italiana *(Italy)*
Bol. Univ. Fed. Parana, Fis. Teor.
*Boletim da Universidade Federal do Parana, Fisica Teorica *(Brazil)*
Brain Res.
Brain Research *(Netherlands)*
Brit. Food J.
British Food Journal *(England)*
Brit. J. Plast. Surg.
British Journal of Plastic Surgery *(Scotland)*
Brit. Mycol. Soc. Trans.
British Mycological Society Transactions, The *(England)*
Brit. Plast.
British Plastics *(England)*
Bull. Astron.
Bulletin Astronomique *(France)*
Bull. Astron. Inst. Neth., Suppl. Ser.
Bulletin of the Astronomical Institutes of the Netherlands, Supplement Series *(Netherlands)*
Bull. Belgicatom
Bulletin Belgicatom (formerly Belgicatom, Association Belge pour le Developpement Paficique de l'Energie Atomique, Bulletin d'Information) *(Belgium)*
Bull. Belg. Phys. Soc.
Bulletin of the Belgian Physical Society (formerly Bulletin de la Societe Belge de Physique) *(Belgium)*
Bull. Calcutta Math. Soc.
Bulletin of the Calcutta Mathematical Society *(India)*
Bull. Dir. Etud. Rech.
Bulletin de la Direction des Etudes et Recherches *(France)*
Bull. Earthquake Res. Inst., Univ. Tokyo
Bulletin of the Earthquake Research Inst., University of Tokyo
see Tokyo Daigaku Jishin Kenkyusho Iho
Bull. Eidgenoess. Gesundh., Beil. B
Bulletin des Eidgenoessisches Gesundheitsamtes, Beilage B *(Switzerland)*
Bull. Entomol. Res.
Bulletin of Entomological Research *(England)*
Bull. Fac. Eng., Hiroshima Univ.
Bulletin of the Faculty of Engineering, Hiroshima University
see Hiroshima Daigaku Kogakubu Kenkyu Hokoku
Bull. Fac. Sci. Eng., Chuo Univ.
Bulletin of the Faculty of Science and Engineering, Chuo University
see Chuo Daigaku Rikogakubu Kiyo
Bull. Geophys. Observ., Haile Sellassie I Univ.
Bulletin of the Geophysical Observatory, Haile Sellassie I University *(Ethopia)*
Bull. Inst. Geophys., Nat. Cent. Univ.
*Bulletin of the Institute of Geophysics, National Central University *(China (Taiwan))*
Bull. Inst. Int. Froid, Annexe
Bulletin de l'Institut International du Froid, Annexe *(France)*
Bull. Inst. Nat. Sante Rech. Med.
Bulletin de l'Institut National de la Sante et de la Recherche Medicale *(France)*
Bull. Inst. Space Aeronaut. Sci., Univ. Tokyo
Bulletin of the Institute of Space and Aeronautical Science, University of Tokyo
see Tokyo Daigaku Uchu Koku Kenkyusho Hokoku
Bull Int. Inst. Refrig., Suppl.
Bulletin of the International Institute of Refrigeration, Supplement
see Bull. Inst. Int. Froid, Annexe
Bull. Kyoto Educ. Univ., Ser. B
Bulletin of the Kyoto Educational University, Series B. Mathematics and Natural Science *(Japan)*
Bull. Office Int. Epizoot.
Bulletin de l'Office International des Epizooties *(France)*
Bull. Res. Inst. Miner. Dressing Met., Tohoku Univ.
Bulletin of the Research Inst. of Mineral Dressing and Metallurgy, Tohoku University
see Tohoku Daigaku Senko Seiren Kenkyusho Iho
Bull. Soc. Roy. Bot. Belg.
Bulletin de la Societe Royale de Botanique de Belgique *(Belgium)*
Bull. Tulane Univ. Med. Fac.
Bulletin of the Tulane University Medical Faculty *(U.S.)*
Bull. Volcanol.
Bulletin Volcanologique *(Italy)*
Bul. Stiint. Teh. Inst. Politeh. Timisoara
Buletinul Stiintific si Tehnic al Institutului Politehnic Timisoara *(Romania)*
Bus. Syst. Equip.
Business Systems and Equipment *(England)*
Bus. Week
Business Week *(U. S.)*
Byggmesteren
Byggmesteren (Norges Byggforskningsinstitutt) *(Norway)*
Byull. Inst. Teor. Astron.
Byulleten Instituta Teoreticheskoi Astronomii *(U.S.S.R.)*
Byull. Kom. Opred. Absol. Geol. Form.
Byulleten Komissii po Opredeleniyu Absolyutnogo Vozrasta Geologicheskikh Formatsii *(U.S.S.R.)*
CA–Cancer J. Clin.
CA– Cancer Journal Clinicians *(U.S.)*
Cah. Ing. Agron.
Cahiers des Ingenieurs Agronomes *(France)*
Cah. Oceanogr.
Cahiers Oceanographiques *(France)*
Calcified Tissue Res.
Calcified Tissue Research *(West Germany)*
Can. J. Ophthalmol.
Canadian Journal of Ophthalmology *(Canada)*
Can. J. Psychol.
Canadian Journal of Psychology *(Canada)*
Can. Mach. Metalwork.
Canadian Machinery and Metalworking *(Canada)*
Canner/Packer
Canner/Packer *(U. S.)*
Can. Nurse
Canadian Nurse *(Canada)*
Cercet. Met.
Cercetari Metalurgice *(Romania)*
Chem. Process. (London)
Chemical Processing (London) *(England)*
Chesapeake Sci.
Chesapeake Science *(U. S.)*
Chim. Ind., Genie Chim.
Chimie et Industrie, Genie Chimique (formed by the merger of Chimie et Industrie (Paris) and Genie Chimique (Paris)) *(France)*
Chin. Anim. Husb. Vet. Med.
Chinese Animal Husbandry and Veterinary Medicine

see *Chung Kuo Hsu Mu Shou I*

Chin. J. Dermatol.
Chinese Journal of Dermatology
see *Chung Hua P'i Fu K'o Tsa Chih*

Chin. J. Gynecol. Obstet.
Chinese Journal of Gynecology and Obstetrics
see *Chung Hua Fu Ch'an K'o Tsa Chih*

Chin. J. Phys. (Peking) (Engl. Transl.)
*Chinese Journal of Physics (Peking) (English Translation of Acta Physica Sinica (Wu Li Hsueh Pao)) *(U. S.)*

Chin. J. Surg.
Chinese Journal of Surgery
see *Chung Hua Wai K'o Tsa Chih*

Chung Hua Fu Ch'an K'o Tsa Chih
Chung Hua Fu Ch'an K'o Tsa Chih (Chinese Journal of Gynecology and Obstetrics) *(China)*

Chung Hua I Hsueh Tsa Chih
Chung Hua I Hsueh Tsa Chih (National Medical Journal of China) *(China)*

Chung Hua P'i Fu K'o Tsa Chih
Chung Hua P'i Fu K'o Tsa Chih (Chinese Journal of Dermatology) *(China)*

Chung Hua Wai K'o Tsa Chih
Chung Hua Wai K'o Tsa Chih (Chinese Journal of Surgery) *(China)*

Chung Kuo Hsu Mu Shou I
Chung Kuo Hsu Mu Shou I (Chinese Animal Husbandry and Veterinary Medicine) *(China)*

Chuo Daigaku Rikogakubu Kiyo
Chuo Daigaku Rikogakubu Kiyo (Bulletin of the Faculty of Science and Engineering, Chuo University) *(Japan)*

Civil Eng. (N. Y.)
Civil Engineering (New York) *(U. S.)*

Coal Age
Coal Age *(U. S.)*

Cobalt
Cobalt *(France)*

Colloid J. (USSR) (Engl. Transl.)
Colloid Journal (USSR) (English Translation of Kolloidnyi Zhurnal) *(U. S.)*

Colloq. Int. Cent. Nat. Rech. Sci.
Colloques Internationaux du Centre National de la Recherche Scientifique *(France)*

Combustion
Combustion *(U.S.)*

Commer. Fish. Rev.
Commercial Fisheries Review *(U. S.)*

Commun. Math. Phys.
Communications in Mathematical Physics *(West Germany)*

Compt. Rend. Soc. Geol. Fr.
Compte Rendu Sommaire des Seances de la Societe Geologique de France *(France)*

Comput. Biomed. Res.
Computers and Biomedical Research *(U. S.)*

Concrete J.
Concrete Journal
see *Konkurito Janaru*

Constr. Masini
Constructia de Masini *(Romania)*

Coord. Chem. Rev.
Coordination Chemistry Reviews *(Netherlands)*

Corros. Prev. Contr.
Corrosion Prevention and Control *(England)*

Cuivre, Laitons, Alliages
Cuivre, Laitons, Alliages *(France)*

Curr. Awareness Bull.
Current Awareness Bulletin *(U. S.)*

Curr. Mod. Biol.
Currents in Modern Biology *(Netherlands)*

Czas. Stomatol.
Czasopismo Stomatologiczne *(Poland)*

Dan. Med. Bull.
Danish Medical Bulletin *(Denmark)*

Denki Shikenjo Kenkyu Hokoku
Denki Shikenjo Kenkyu Hokoku (Researches of the Electrotechnical Laboratory) *(Japan)*

Desalination
Desalination *(Netherlands)*

Deut. Hydrogr. Z.
Deutsche Hydrographische Zeitschrift *(West Germany)*

Deut. Zahn-, Mund- Kieferheilk.
Deutsche Zahn-, Mund- und Kieferheilkunde mit Zentralblatt fuer die Gesamte Zahn-, Mund- und Kieferheilkunde *(East Germany)*

Diffus. Data
*Diffusion Data *(U. S.)*

DMIC Rev.
DMIC Review of Recent Developments *(U. S.)*

Doboku Gijutsu
Doboku Gijutsu (Civil Engineering) *(Japan)*

Doc-Air-Espace
*Doc-Air-Espace *(France)*

Dokl.–Bot. Sci. Sect. (Engl. Transl.)
Doklady–Botanical Sciences Sections (English Translation) *(U.S.)*

Earth-Sci. Rev.
Earth-Science Reviews *(Netherlands)*

Eiyo To Shokuryo
Eiyo To Shokuryo (Journal of Japanese Society of Food and Nutrition) *(Japan)*

Ekon. Samf. Tidskr.
Ekonomiska Samfundets Tidskrift *(Sweden)*

Electron. Equip. News
Electronic Equipment News *(England)*

Electron. Ind. (Paris).
Electronique Industrielle (Paris) *(France)*

Electron. Packag. Prod.
Electronic Packaging and Production *(U. S.)*

Electrotechniek
Electrotechniek *(Netherlands)*

Elec. World
Electrical World *(U. S.)*

Elec. World (Shanghai)
Electrical World (Shanghai)
see *Tien Shih Chieh*

Elektromedizin
Elektromedizin und Ihre Grenzgebiete *(Germany)*

Elektron. Bol'shikh Moshch.
Elektronika Bol'shikh Moshchnostei *(U.S.S.R.)*

Elektron. Obrab. Mater.
Elektronnaya Obrabotka Materialov *(Moldavian S.S.R.)*

Elektron. Rechenanlagen
Elektronische Rechenanlagen *(West Germany)*

Elektrotech. Cas.
Elektrotechnicky Casopis *(Czechoslovakia)*

Elektrotekhnika
Elektrotekhnika *(U.S.S.R.)*

Elektr. Sta.
Elektricheskie Stantsii *(U.S.S.R.)*

Engei Gakkai Zasshi
Engei Gakkai Zasshi (Journal of the Japanese Society for Horticultural Science) *(Japan)*

Engl. Elec. J.
English Electric Journal *(England)*

Entropie
Entropie *(France)*

Environ. Res.
Environmental Research *(U. S.)*

Ergonomics
Ergonomics *(England)*

Euratom Rev.
*Euratom Review of the European Atomic Energy Community (formerly Euratom Bulletin) *(Belgium)*

Exp. Pathol.
Experimentelle Pathologie *(East Germany)*

Farm, Ranch, Home Quart.
Farm, Ranch and Home Quarterly *(U. S.)*

FDA (Food Drug Admin.) Pap.
FDA (Food and Drug Administration) Papers *(U. S.)*

Fiz. Chastits Vys. Energ., Akad. Nauk Gruz. SSSR, Inst. Fiz.
Fizika Chastits Vysokikh Energii, Akademiya Nauk Gruzinskoi SSR, Institut Fiziki *(Georgian S.S.R.)*

Fiziol. Norm. Patol. (Bucharest)
Fiziologia Normala si Patologica (Bucharest) *(Romania)*

Fiz. Khim. Obrab. Mater.
Fizika i Khimiya Obrabotki Materialov *(U.S.S.R.)*

Fiz. Tekh. Poluprov.
*Fizika i Tekhnika Poluprovodnikov *(U.S.S.R.)*

Flame Notes, Beckman
Flame Notes, Beckman *(U. S.)*

FOA (Forsvarets Forsk.) Rep.
*FOA (Forsvarets Forskningsanstalt) Reports *(Sweden)*

Folia Haematol. (Leipzig)
Folia Haematologia (Leipzig) *(East Germany)*

Folia Med. Cracov.
Folia Medica Cracoviensia *(Poland)*

Food Eng. (Philadelphia)
Food Engineering (Philadelphia) (formerly Food Industries) *(U. S.)*

Forest. Abstr.
Forestry Abstracts *(England)*

Forsch. Ingenieurw.

Forschung im Ingenieurwesen *(West Germany)*

Fortschr. Hochpolym.-Forsch.
Fortschritte der Hochpolymeren-Forschung *(West Germany)*

Fortschr. Zool.
Fortschritte de Zoologie *(West Germany)*

Foundry
Foundry *(U. S.)*

Freiberg. Forschungsh., B
Freiberger Forschungshefte, Reihe B *(East Germany)*

Fukuoka Acta Med.
Fukuoka Acta Medica
see Fukuoka Igaku Zasshi

Fukuoka Igaku Zasshi
Fukuoka Igaku Zasshi (Fukuoka Acta Medica) *(Japan)*

Fukushima Daigaku Gakugei Gakubu Rika Hokoku
Fukushima Daigaku Gakugei Gakubu Rika Hokoku (The Science Reports of the Faculty of Arts and Science, Fukushima University) *(Japan)*

Genet. Pol.
*Genetica Polonica *(Poland)*

Geofiz. Byull.
Geofizicheskii Byulleten *(U.S.S.R.)*

Geofys. Sb.
Geofysikalni Sbornik *(Czechoslovakia)*

Geol. Geofiz.
Geologiya i Geofizika *(U.S.S.R.)*

Geol. Nefti Gaza
Geologiya Nefti i Gaza† *(U.S.S.R.)*

Geophys. Geol. (Leipzig)
Geophysik und Geologie (Leipzig) *(East Germany)*

Gidroaeromekhanika
Gidroaeromekhanika *(Ukrainian S.S.R.)*

Giesserei
Giesserei *(West Germany)*

Glas-Instrum.-Tech.
Glas-Instrumenten-Technik *(West Germany)*

Glass Ceram. (USSR) (Engl. Transl.)
Glass and Ceramics (USSR) (English Translation of Steklo i Keramika) *(U. S.)*

Grinding Finish.
Grinding and Finishing *(U. S.)*

Haematologia (Budapest)
Haematologia (Budapest) *(Hungary)*

Haikan Gijutsu
Haikan Gijutsu (The Piping Engineering) *(Japan)*

Handb. Med. Radiol.
Handbuch der Medizinschen Radiologie *(West Germany)*

Harper Hosp. Bull.
Harper Hospital Bulletin *(U. S.)*

Health Lab. Sci.
Health Laboratory Science *(U. S.)*

Heidelberg. Akad. Wiss. Math.-Naturwiss. Kl., Sitzungsber.
Heidelberger Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Klasse, Sitzungsberichte *(West Germany)*

Hemel Dampkring
Hemel en Dampkring *(Belgium)*

Hiroshima Daigaku Kogakubu Kenkyu Hokoku
Hiroshima Daigaku Kogakubu Kenkyu Hokoku (Bulletin of the Faculty of Engineering, Hiroshima University) *(Japan)*

Hoken Butsuri
Hoken Butsuri (Journal of Japan Health Physics Society) *(Japan)*

Hokkaidoritsu Eisei Kenkyushoho
Hokkaidoritsu Eisei Kenkyushoho (Report of the Hokkaido Inst. of Public Health) *(Japan)*

Hokuno
Hokuno (Agriculture in Hokkaido) *(Japan)*

Honvedorvos
Honvedorvos *(Hungary)*

Hyg. Sanit. (USSR) (Engl. Transl.)
Hygiene and Sanitation (USSR) (English Translation of Gigiena i Sanitariya) *(U. S.)*

Hyogo Noka Daigaku Kiyo
Hyogo Noka Daigaku Kiyo (Memoirs of the Hyogo University of Agriculture) *(Japan)*

Idengaku Zasshi, Suppl.
Idengaku Zasshi, Supplement (Japanese Journal of Genetics, Supplement) *(Japan)*

IEEE (Inst. Elec. Electron. Eng.) Trans. Audio Electroacoust.
*IEEE (Institute of Electrical and Electronics Engineers) Transactions on Audio and Electroacoustics *(U.S.)*

Ind.-Anz.
Industrie-Anzeiger *(West Germany)*

Ind.-Elektron. Forsch. Fertigung
Industrie-Elektronik in Forschung und Fertigung *(West Germany)*

Indian J. Agr. Sci.
Indian Journal of Agricultural Science, The *(India)*

Indian J. Appl. Chem.
Indian Journal of Applied Chemistry *(India)*

Indian J. Cancer
Indian Journal of Cancer *(India)*

Indian J. Occup. Health
Indian Journal of Occupational Health *(India)*

Indian Pediat.
Indian Pediatrics *(India)*

Ind. Mineraria
Industria Mineraria *(Italy)*

Ind. Water Eng.
Industrial Water Engineering *(U. S.)*

Inform. Byull. Sov. Antarkt. Eksped.
Informatsionnyi Byulleten Sovetskoi Antarkticheskoi Ekspeditsii *(U.S.S.R.)*

Ing. Bygningsv., Ugeovers.
Ingenieor- og Bygningsvaesen, Ugeoversigt *(Denmark)*

Inst. Mining Met., Trans./Sect. B
Institution of Mining and Metallurgy, Transactions/Section B. Applied Earth Science (continues in part Transactions of the Institution of Mining and Metallurgy) *(England)*

Inst. Petrol. Rev.
Institute of Petroleum Review, The *(England)*

Instrum. Contr. Eng.
Instrument and Control Engineering *(England)*

Instrum. Med.
Instrumentation in Medicine *(England)*

Int. Ass. Sci. Hydrol., Bull.
International Association of Scientific Hydrology, Bulletin *(Belgium)*

Int. Chem. Eng.
*International Chemical Engineering. A Quarterly Journal of Translations from Russia, Eastern Europe, and Asia *(U. S.)*

Int. J. Neurol.
International Journal of Neurology *(U. S.)*

Int. Rev. Gesam. Hydrobiol.
Internationale Revue der Gesamten Hydrobiologie *(East Germany)*

Int. Surg.
International Surgery *(U. S.)*

Inzh. Zh., Mekh. Tverd. Tela
Inzhenernyi Zhurnal, Mekhanika Tverdogo Tela (formerly Inzhenernyi Zhurnal) *(U.S.S.R.)*

Iron Age Metalwork. Int.
Iron Age Metalworking International *(U. S.)*

ISA (Instrum. Soc. Amer.), Proc., Nat. Power Instrum. Symp.
ISA (Instrument Society of America), Proceedings, National Power Instrumentation Symposium *(U. S.)*

Issled. Genet.
Issledovaniya po Genetike *(U.S.S.R.)*

Issled. Primen. Tsifrovykh Analogovykh Vychisl. Mash. Yad. Fiz. Tekh., Sb. Statei (U.S.S.R.)
*Issledovanie Primenenii Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike, Moskovskii Inzhenerno-Fizicheskii Institut, Sbornik Statei *(U.S.S.R.)*

Izobret., Prom. Obraztsy, Tovarnye Znaki
Izobreteniya, Promyshlennye Obraztsy, Tovarnye Znaki *(U.S.S.R.)*

Izv. Akad. Nauk Arm. SSR, Biol. Nauki
Izvestiya Akademii Nauk Armyanskoi SSR, Biologicheskie Nauki (superseded by Biologicheskii Zhurnal Armenii) *(Armenian S.S.R.)*

Izv. Akad. Nauk Arm. SSR, Ser. Tekh. Nauk
Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Tekhnicheskikh Nauk *(Armenian S.S.R.)*

Izv. Akad. Nauk Kaz. SSR, Ser. Khim.
Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Khimicheskaya *(Kazakh S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Biol.
Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Geol.
Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Mat.
Izvestiya Akademii Nauk SSSR, Seriya Matematicheskaya *(U.S.S.R.)*

Izv. Akad. Nauk Tadzh. SSR, Otd. Fiz.-Tekh. Khim. Nauk
Izvestiya Akademii Nauk Tadzhikskoi SSR, Otdelenie Fiziko-Tekhnicheskikh i Khimicheskikh Nauk *(Tadzhik S.S.R.)*

Izv. Inst. Elektron., Bulg. Akad. Nauk.
Izvestiya na Instituta po Elektronika, Bulgarska Akademiya na

Naukite *(Bulgaria)*

Izv. Inst. Khidrol. Meteorol., Bulg. Akad. Nauk.
Izvestiya na Institutapo Khidrologiya i Meteorologiya, Bulgarska Akademiya na Naukite, Otdelenie za Matematicheski i Fizicheski Nauki *(Bulgaria)*

Izv. Vyssh. Ucheb. Zaved., Mat.
*Izvestiya Vysshikh Uchebnykh Zavedenii, Matematika *(U.S.S.R.)*

Izv. Vyssh. Ucheb. Zaved., Priborostr.
Izvestiya Vysshikh Uchebnykh Zavedenii, Priborostroenie *(U.S.S.R.)*

Izv. Vyssh. Ucheb. Zaved., Tekhnol. Legk. Prom.
Izvestiya Vysshikh Uchebnykh Zavedenii, Tekhnologiya Legkoi Promyshlennosti *(Ukrainian S.S.R.)*

J. Amer. Podiat. Ass.
Journal of the American Podiatry Association *(U. S.)*

Jap. J. Dairy Sci.
Japanese Journal of Dairy Science (Japan)
see Rakuno Kagaku no Kenkyu

Jap. J. Exp. Morphol.
Japanese Journal of Experimental Morphology
see Jikken Keitaigakushi

Jap. J. Genet., Suppl.
Japanese Journal of Genetics, Supplement
see Idengaku Zasshi, Suppl.

Jap. J. Pharm. Chem.
Japanese Journal of Pharmacy and Chemistry
see Yakugaku Kenkyu

Jap. J. Zootech. Sci.
Japanese Journal of Zootechnical Science
see Nippon Chikusangaku Kaiho

JARE Sci. Rep., Spec. Issue
JARE Scientific Reports, Special Issue *(Japan)*

J. Ass. Phys. Ment. Rehabil.
Journal of the Association for Physical and Mental Rehabilitation *(U. S.)*

J. Aust. Ceram. Soc.
Journal of the Australian Ceramic Society *(Australia)*

J. Balneol. Soc. Jap.
Journal of the Balneological Society of Japan
see Onsen Kagaku

J. Belge Radiol., Monogr.
*Journal Belge de Radiologie, Monographie *(Belgium)*

J. Brit. Ceram. Soc.
Journal of the British Ceramic Society, The *(England)*

J. Cell Sci.
*Journal of Cell Science *(England)*

J. Cryst. Growth
Journal of Crystal Growth *(Netherlands)*

J. Egypt. Public Health Ass.
Journal of the Egyptian Public Health Association *(Egypt)*

Jemna Mech. Opt.
Jemna Mechanika a Optika *(Czechoslovakia)*

Jeune Sci.
Jeune Scientifique *(Canada)*

J. Food Sci. Technol.
Journal of Food Science and Technology
see Nippon Shokuhin Kogyo Gakkaishi

J. Forensic Med.
Journal of Forensic Medicine *(South Africa)*

J. Formosan Med. Ass.
Journal of the Formosan Medical Association
see T'ai-wan I Hsueh Hui Tsa Chih

J. Fuel Heat. Technol.
Journal of Fuel and Heating Technology *(England)*

J. Geol.
Journal of Geology *(U. S.)*

Jibiinkoka Rinsho
Jibiinkoka Rinsho (Oto-Rhino-Laryngological Clinic) *(Japan)*

Jikken Keitaigakushi
Jikken Keitaigakushi (Japanese Journal of Experimental Morphology) *(Japan)*

J. Indian Soc. Soil Sci.
Journal of the Indian Society of Soil Science *(India)*

J. Inst. Safety High Pressure Gas Eng.
Journal of the Inst. of Safety of High Pressure Gas Engineering
see Koatsu Gasu

J. Inst. Telecommun. Eng.
Journal of the Institution of Telecommunication Engineers *(India)*

J. Irrig. Drain. Div., Amer. Soc. Civil Eng.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers *(U. S.)*

J. Jap. Health Phys. Soc.
Journal of Japan Health Physics Society
see Hoken Butsuri

J. Jap. Med. Ass.
Journal of the Japan Medical Association, The
see Nippon Ishikai Zasshi

J. Jap. Soc. Food Nutr.
Journal of Japanese Society of Food and Nutrition
see Eiyo To Shokuryo

J. Jap. Soc. Hort. Sci.
Journal of the Japanese Society for Horticultural Science
see Engei Gakkai Zasshi

J. Jap. Stomatol. Soc.
Journal of the Japan Stomatological Society, The
see Kokubyo Gakkai Zasshi

J. Jap. Tech. Ass. Pulp Pap. Ind.
Journal of the Japanese Technical Association of Pulp and Paper Industry
see Kami Pa Gikyoshi

J. Jap. Wood Res. Soc.
Journal of the Japan Wood Research Society
see Mokuzai Gakkaishi

J. Karnatak Univ.
Journal of the Karnatak University *(India)*

J. Macromol. Sci., Part A
Journal of Macromolecular Science, Part A. Chemistry (supersedes Journal of Macromolecular Chemistry) *(U. S.)*

J. Marine Res.
Journal of Marine Research (Sears Foundation for Marine Research) *(U.S.)*

J. Metal Finish. Soc. Jap.
Journal of the Metal Finishing Society of Japan, The
see Kinzoku Hyomen Gijutsu

J. Nagasaki Med. Ass., Suppl.
Journal of the Nagasaki Medical Association, Supplement
see Nagasaki Igakkai Zasshi, Suppl.

J. Nucl. Med., Suppl.
*Journal of Nuclear Medicine, Supplement *(U.S.)*

J. Nucl. Sci. (Seoul)
*Journal of Nuclear Sciences (Seoul) (Wonjaryogwon. Yon'gu Nonmun Chip) *(South Korea)*

J. Osaka Univ. Dent. Soc.
Journal of the Osaka University Dental Society, The
see Osaka Daigaku Shigaku Zasshi

J. Paleontol.
Journal of Paleontology *(U.S.)*

J. Phys., A (London)
*Journal of Physics, A (London), Proceedings of the Physical Society (General) (supersedes in part Proceedings of the Physical Society (London)) *(England)*

J. Phys., B (London)
*Journal of Physics, B (London), Proceedings of the Physical Society (Atomic and Molecular Physics) (supersedes in part Proceedings of the Physical Society (London)) *(England)*

J. Phys., C (London)
*Journal of Physics, C (London), Proceedings of the Physical Society (Solid State Physics) (supersedes in part Proceedings of the Physical Society (London)) *(England)*

J. Phys., E (London)
*Journal of Physics, E (London) (supersedes Journal of Scientific Instruments) *(England)*

J. Phys. Chem. Solids, Suppl.
*Journal of Physics and Chemistry of Solids, Supplement *(England)*

J. Phys. Soc. Jap., Suppl.
*Journal of the Physical Society of Japan, Supplement *(Japan)*

J. Radiol. Phys. Ther., Univ. Kanazawa
Journal of Radiology and Physical Therapy, University of Kanazawa, The
see Kanazawa Irigaku Sosho

J. Roy. Army Med. Corps
Journal of the Royal Army Medical Corps *(England)*

J. Soc. Eng. Miner. Springs, Jap.
Journal of the Society of Engineers for Mineral Springs, Japan
see Onsen Kogakkaishi

J. Soc. Fiber Sci. Technol., Jap.
Journal of the Society of Fiber Science and Technology, Japan
see Sen'i Gakkaishi

J. Soc. Instrum. Contr. Eng.
Journal of the Society of Instrument and Control Engineers
see Keisoku To Seigyo

J. Soc. Leather Trades Chem.
Journal of the Society of Leather Trades Chemists *(England)*

J. Soc. Rubber Ind., Jap.
Journal of the Society of Rubber Industry, Japan
see Nippon Gomu Kyokaishi

J. Tokyo Women's Med. Coll.
Journal of Tokyo Women's Medical College
see Tokyo Joshi Ika Daigaku Zasshi

Jugoslov. Pronalazastvo
Jugoslovensko Pronalazastvo *(Yugoslavia)*

Kagaku Keisatsu Kenkyusho Hokoku
Kagaku Keisatsu Kenkyusho Hokoku (Reports of the National Research Inst. of Police Science) *(Japan)*

Kagoshima Daigaku Suisangakubu Kiyo
Kagoshima Daigaku Suisangakubu Kiyo (Memoirs of the Faculty of Fisheries, Kagoshima University) *(Japan)*

Kaibogaku Zasshi
Kaibogaku Zasshi (Acta Anatomica Nipponica) *(Japan)*

Kali Steinsalz
Kali und Steinsalz *(West Germany)*

Kami Pa Gikyoshi
Kami Pa Gikyoshi (Journal of the Japanese Technical Association of Pulp and Paper Industry) *(Japan)*

Kanazawa Irigaku Sosho
Kanazawa Irigaku Sosho (Journal of Radiology and Physical Therapy, University of Kanazawa, The) *(Japan)*

Keisoku To Seigyo
Keisoku To Seigyo (Journal of the Society of Instrument and Control Engineers) *(Japan)*

Kinzoku Hyomen Gijutsu
Kinzoku Hyomen Gijutsu (The Journal of the Metal Finishing Society of Japan) *(Japan)*

Kleinheubacher Ber.
Kleinheubacher Berichte *(East Germany)*

Klin. Monatsbl. Augenheilk.
Klinische Monatsblaetter fuer Augenheilkunde und fuer Augenaerztliche Fortbildung *(West Germany)*

Koatsu Gasu
Koatsu Gasu (Journal of the Inst. of Safety of High Pressure Gas Engineering) *(Japan)*

Kobe Kogyo Giho
Kobe Kogyo Giho (Kobe Kogyo Technical Report) *(Japan)*

Kobe Kogyo Tech. Rep.
Kobe Kogyo Technical Report
see Kobe Kogyo Giho

K'o Hsueh Tu Chung
K'o Hsueh Tu Chung (Popular Science) *(China)*

Kokubyo Gakkai Zasshi
Kokubyo Gakkai Zasshi (Journal of the Japan Stomatological Society, The) *(Japan)*

Konkurito Jonaru
Konkurito Jonaru (Concrete Journal) *(Japan)*

Konserv. Ovoshchesush. Prom.
Konservnaya i Ovoshchesushil'naya Promyshlennost *(U.S.S.R.)*

Korroz. Metal. Splavov
Korroziya Metallov i Splavo *(U.S.S.R.)*

Kosm. Biol. Med.
Kosmicheskaya Biologiya i Meditsina *(U.S.S.R.)*

Kosm. Luchi
Kosmicheskie Luchi *(U.S.S.R.)*

Kovove Mater.
Kovove Materialy *(Czechoslovakia)*

Kowan Giken Shiryo
Kowan Giken Shiryo (Technical Note of Port and Harbour Technical Research Inst., Ministry of Transportation, Japan) *(Japan)*

Krist. Tech.
Kritstall und Technik *(East Germany)*

Kuki Seijo
Kuki Seijo (Air Cleaning) *(Japan)*

Kumamoto Daigaku Kogakubu Kenkyu Hokoku
Kumamoto Daigaku Kogakubu Kenkyu Hokoku (Technical Reports of the Kumamoto University) *(Japan)*

Kumamoto Daigaku Kyoikugakubu Kiyo
Kumamoto Daigaku Kyoikugakubu Kiyo (Memoirs of the Faculty of Education, Kumamoto University) *(Japan)*

Kurznachr. Akad. Wiss. Goettingen
Kurznachrichten der Akademie der Wissenschaften in Goettingen *(West Germany)*

Kyoto Daigaku Kogyo Kyoin Yoseijo Kenkyu Hokoku
Kyoto Daigaku Kogyo Kyoin Yoseijo Kenkyu Hokoku (Report of the Training Inst. for Engineering Teachers, Kyoto University) *(Japan)*

Kyushu Daigaku Kogaku Shuho
Kyushu Daigaku Kogaku Shuho (Technology Reports of the Kyushu University) *(Japan)*

Kyushu Daigaku Seisan Kagaku Kenkyusho Hokoku
Kyushu Daigaku Seisan Kagaku Kenkyusho Hokoku (The Reports of the Research Inst. of Science and Industry, Kyushu University) *(Japan)*

Lakokrasoch. Mater. Ikh Primen.
Lakokrasochnye Materialy i Ikh Primenenie *(U.S.S.R.)*

Landbouwtijdschrift
Landbouwtijdschrift *(Belgium)*

Lasers Opt. Non Conv.
Lasers et Optique Non Conventionelle *(France)*

Lebensversicherungsmedizin
Lebensversicherungsmedizin *(West Germany)*

Light Metals
Light Metals (superseded by Light Metals and Metals Industry (London)) *(England)*

Light Metals Metal Ind. (London)
*Light Metals and Metal Industry (London) (formed by merger of Light Metals and The Metal Industry (London)) *(England)*

Lipids
Lipids *(U. S.)*

Liteinoe Proizvod.
Liteinoe Proizvodstvo *(U.S.S.R.)*

Lutte Cancer
Lutte Contre le Cancer *(France)*

Machinery (N. Y.)
Machinery (New York) *(U. S.)*

Mach. Prod. Eng.
Machinery and Production Engineering *(England)*

Mach. Shop Eng. Mfg.
Machine Shop and Engineering Manufacture *(England)*

Mach. Tool Blue Book
Machine and Tool Blue Book *(U. S.)*

Mag. Stand.
Magazine of Standards *(U. S.)*

Magy. Traumatol., Orthop. Helyreallito Sebesz.
Magyar Traumatologia, Orthopaedia es Helyreallito Sebeszet *(Hungary)*

Manage. Sci.
Management Science *(U.S.)*

Mashinovedenie
Mashinovedenie *(U.S.S.R.)*

Mass Prod.
Mass Production *(England)*

Mater. Res. Bull.
Materials Research Bulletin *(U. S.)*

Mech. World Eng. Rec.
*Mechanical World and Engineering Record *(England)*

Med. Bull. U. S. Army, Eur.
Medical Bulletin of the U. S. Army, Europe *(U.S.)*

Med. Nucl.-Radiobiol. Lat., Suppl.
*Medicina Nucleare–Radiobiologica Latina, Suppl. *(Italy)*

Med. Radiol. (USSR) (Engl. Transl.)
Medical Radiology (USSR) (English Translation of Meditsinskaya Radiologiya) *(U. S.)*

Mekh. Polim.
Mekhanika Polimerov *(Latvian S.S.R.)*

Mekh. Razrusheniya Metal., Akad. Nauk Ukr. SSR, Respub. Mezhvedom. Sb.
Mekhanizm Razrusheniya Metallov, Akademiya Nauk Ukrainskoi SSR, Respublikanskii Mezhvedomstvennyi Sbornik *(Ukrainian S.S.R.)*

Mem. Fac. Educ., Kumamoto Univ.
Memoirs of the Faculty of Education, Kumamoto University
see Kumamoto Daigaku Kyoikugakubu Kiyo

Mem. Fac. Fish., Kagoshima Univ.
Memoirs of the Faculty of Fisheries, Kagoshima University
see Kagoshima Daigaku Suisangakubu Kiyo

Mem. Fac. Sci., Kyoto Univ., Ser. Biol.
Memoirs of the Faculty of Science, Kyoto University, Series of Biology (formerly Memoirs of the College of Science, University of Kyoto, Series B (Biology)) *(Japan)*

Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.
Memoirs of the Faculty of Science, Kyoto University, Series of Physics, Astrophysics, Geophysics, and Chemistry (formerly Memoirs of the College of Science, University of Kyoto, Series A) *(Japan)*

Mem. Hyogo Univ. Agr.
Memoirs of the Hyogo University of Agriculture
see Hyogo Noka Daigaku Kiyo

Meres Automat.
Meres es Automatika *(Hungary)*

Mes., Regul., Automat.
Mesures, Regulation, Automatisme *(France)*

Metabolism
*Metabolism: Clinical and Experimental *(U. S.)*

Metal Finish.
Metal Finishing *(U. S.)*

Metallwirtschaft
Metallwirtschaft–Wissenschaft–Technik *(Germany)*

Metals (London)
Metals (London) *(England)*

Metals Abstr.

*Metals Abstracts (successor to Review of Metal Literature and Metallurgical Abstracts) *(U. S.-England)*

Metal Sci. Heat Treat. (USSR) (Engl. Transl.)
Metal Science and Heat Treatment (USSR) (English Translation of Metallovedenie i Termicheskaya Obrabotka Metallov) *(U. S.)*

Metal Treat.
Metal Treating *(U. S.)*

Met. Elec. (Madrid)
Metalurgia y Electricidad (Madrid) *(Spain)*

Meteoritika
Meteoritika *(U.S.S.R.)*

Method. Phys. Anal.
Methodes Physiques d'Analyse *(France)*

Met. Rev. (Publ. in Metals Mater.)
Metallurgical Reviews (Published in Metals and Materials) *(England)*

Met. Spec. (Paris)
Metallurgie Speciale (Paris) *(France)*

Microwaves
Microwaves *(U. S.)*

Mie Kaibo Gyosekishu
Mie Kaibo Gyosekishu *(Japan)*

Milk Dealer
Milk Dealer, The *(U. S.)*

Miner. Deposita
Mineralium Deposita *(West Germany)*

Minerva Med. Sicil.
*Minerva Medica Siciliana (continuation of Gazzetta Medica Siciliana) Supplemento a Minerva Medica *(Italy)*

Minerva Med., Suppl.
*Minerva Medica, Supplemento *(Italy)*

Mines Met.
Mines et Metallurgie *(France)*

Mining Met. Quart. (USSR) (Engl. Transl.), Suppl.
Mining and Metallurgy Quarterly, (USSR) (English Translation of Rudarsko-Metalurski Zbornik, Supplement) *(Yugoslavia)*

Mod. Packag.
Modern Packaging *(U. S.)*

Mokuzai Gakkaishi
Mokuzai Gakkaishi (Journal of the Japan Wood Research Society) *(Japan)*

Mol. Biol.
*Molekulyarnaya Biologiya *(U.S.S.R.)*

Mon. Corresp. Befoerd. Erd Himmelskunde
Monatliche Correspondenz zur Befoerderung der Erd und Himmelskunde *(East Germany)*

Monit. Zool. Ital., Suppl.
Monitore Zoologico Italiano, Supplemento *(Italy)*

Montes
Montes *(Spain)*

Motor Ship
Motor Ship *(England)*

Motortech. Z.
Motortechnische Zeitschrift *(West Germany)*

Muanyag Gumi
Muanyag es Gumi *(Hungary)*

Nachrichtentechnik
Nachrichtentechnik *(East Germany)*

Nagano Kogyo Koto Senmon Gakko Kiyo
Nagano Kogyo Koto Senmon Gakko Kiyo (Research Reports, Nagano Technical College) *(Japan)*

Nagasaki Igakkai Zasshi, Suppl.
Nagasaki Igakkai Zasshi, Supplement (Journal of the Nagasaki Medical Association, Supplement) *(Japan)*

Nan Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh
Nan Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh (Acta Universitatis Nankinensis Scientiarum Naturalium) *(China)*

Nat. Fire Codes
National Fire Codes *(U. S.)*

Nat. Med. J. China
National Medical Journal of China
see *Chung Hua I Hsueh Tsa Chih*

Nauch. Zap. Inst. Mashinoved. Avtomat., Akad. Nauk Ukr. SSR, Ser. Mashinoved.
Nauchnye Zapiski Instituta Mashinovedeniya i Avtomatiki, Akademiya Nauk Ukraninskoi SSR, Seriya Mashinovedeniya *(Ukrainian S.S.R.)*

Neftegazov. Geol. Geofiz.
Neftegazovaya Geologiya i Geofizika *(U.S.S.R.)*

Nerv. Sist., Leningrad. Gos. Univ., Fiziol. Inst.
Nervnaya Sistema, Leningradskii Gosudarstvennyi Universitet imeni A. A. Zhdanova, Fiziologicheskii Institut *(U.S.S.R.)*

Neth. J. Sea Res.
Netherlands Journal of Sea Research *(Netherlands)*

Neues Jahrb. Mineral., Monatsh.
Neues Jahrbuch fuer Mineralogie, Monatshefte *(West Germany)*

Nippon Byori Gakkai Kaishi
Nippon Byori Gakkai Kaishi (Transactiones Societatis Pathologicae Japonicae) *(Japan)*

Nippon Chikusangaku Kaiho
Nippon Chikusangaku Kaiho (Japanese Journal of Zootechnical Science) *(Japan)*

Nippon Geka Hokan
Nippon Geka Hokan (Archiv fuer Japanische Chirurgie) *(Japan)*

Nippon Gomu Kyokaishi
Nippon Gomu Kyokaishi (Journal of the Society of Rubber Industry, Japan) *(Japan)*

Nippon Ishikai Zasshi
Nippon Ishikai Zasshi (The Journal of the Japan Medical Association) *(Japan)*

Nippon Sakumotsu Gakkai Kiji
Nippon Sakumotsu Gakkai Kiji (Proceedings of the Crop Science Society of Japan) *(Japan)*

Nippon Shokuhin Kogyo Gakkaishi
Nippon Shokuhin Kogyo Gakkaishi (Journal of Food Science and Technology) *(Japan)*

Nisshin Seiko Giho
Nisshin Seiko Giho (Technical Report of Nisshin Steel Co., Ltd.) *(Japan)*

Norsk Skogind.
Norsk Skogindustri *(Norway)*

Nucl. Law Bull.
*Nuclear Law Bulletin *(Belgium)*

Nucl. Law Bull., Suppl.
*Nuclear Law Bulletin, Supplement *(Belgium)*

Nukleonika, Supl.
*Nukleonika, Suplement *(Poland)*

N. Z. Sci. Rev.
New Zealand Science Review *(New Zealand)*

Oceanogr. Mag.
Oceanographical Magazine, The *(Japan)*

Ochr. Pr.
Ochrona Pracy *(Poland)*

Odontol. Tidskr.
Odontologisk Tidskrift *(Sweden)*

Oftal'mol. Zh.
Oftal'mologicheskii Zhurnal *(Ukrainian S.S.R.)*

Okayama Daigaku Onsen Kenkyusho Hokoku
Okayama Daigaku Onsen Kenkyusho Hokoku (Papers of the Inst. for Thermal Spring Research, Okayama University) *(Japan)*

Oncol. Radiol.
Oncologia si Radiologia *(Romania)*

Onde Elec., Suppl.
*Onde Electrique, L., Supplement *(France)*

Onsen Kagaku
Onsen Kagaku (Journal of the Balneological Society of Japan) *(Japan)*

Onsen Kogakkaishi
Onsen Kogakkaishi (Journal of the Society of Engineers for Mineral Springs, Japan) *(Japan)*

Opt.-Mekh. Prom.
Optiko-Mekhanicheskaya Promyshlennost *(U.S.S.R.)*

Osaka Daigaku Shigaku Zasshi
Osaka Daigaku Shigaku Zasshi (The Journal of Osaka University Dental Society) *(Japan)*

Osaka Furitsu Kogyo Shoreikan Hokoku
Osaka Furitsu Kogyo Shoreikan Hokoku (Reports of Industrial Research Inst., Osaka Prefecture) *(Japan)*

Oto-Rhino-Laryngol. Clin.
Oto-Rhino-Laryngological Clinic
see *Jibiinkoka Rinsho*

Paperi Puu-Lehdesta
Paperi ja Puu-Lehdesta *(Finland)*

Pap. Inst. Thermal Spring Res., Okayama Univ.
Papers of the Inst. for Thermal Spring Research, Okayama University
see *Okayama Daigaku Onsen Kenkyusho Hokoku*

Pediatrics, Suppl.
Pediatrics, Supplement *(U. S.)*

Pei Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh
Pei Ching Ta Hsueh Hsueh Pao, Tzu Jan K'o Hsueh (Acta Scientiarum Naturalium Universitatis Pekinensis) *(China)*

Photogr. Appl. Sci. Technol.
*Photographic Applications in Science and Technology *(U. S.)*

Phys.-Diaet. Ther.
Physikalisch-Diaetetische Therapie *(West Germany)*

Phys. Earth Planet. Interiors
*Physics of the Earth and Planetary Interiors *(Netherlands)*

Pipes Pipelines Int.
Pipes and Pipelines International (formerly International Pipes

and Pipelines) *(England)*

Piping Eng.
Piping Engineering, The
see *Haikan Gijutsu*

Plant Breed. Abstr.
*Plant Breeding Abstracts *(England)*

Plant Cell Physiol. (Kyoto)
Plant and Cell Physiology (Kyoto) *(Japan)*

Plastics (London)
*Plastics (London) *(England)*

Poluprov. Prib. Ikh Primen., Sb. Statei
Poluprovodnikovye Pribory i Ikh Primenenie, Sbornik Statei *(U.S.S.R.)*

Pop. Sci. (Peking)
Popular Science (Peking)
see *K'o Hsueh Tu Chung*

Poznan. Tow. Przyj. Nauk, Wydz. Lek., Pr. Kom. Farm.
Poznanskie Towarzystwo Przyjaciol Nauk, Wydzial Lekarski, Prace Komisji Farmaceutycznej *(Poland)*

Praxis (Bern)
Praxis (Bern) *(Switzerland)*

Probl. Fiziol. Opt.
Problemy Fiziologicheskoi Optiki *(U.S.S.R.)*

Proc. Amer. Soc. Hort. Sci.
Proceedings of the American Society for Horticultural Science *(U. S.)*

Proc. Astron. Soc. Aust.
Proceedings of the Astronomical Society of Australia *(Australia)*

Proc. Crop Sci. Soc. Jap.
Proceedings of the Crop Science Society of Japan
see *Nippon Sakumotsu Gakkai Kiji*

Prochnost Din. Aviats. Dvigatelei
Prochnost i Dinamika Aviatsionnykh Dvigatelei *(U.S.S.R.)*

Proc. Indian Acad. Sci., Sect. B
Proceedings of the Indian Academy of Sciences, Section B *(India)*

Proc. La. Acad. Sci.
*Proceedings of the Louisiana Academy of Sciences, The *(U. S.)*

Proc. Nat. Acad. Sci., India, Sect. A
Proceedings of the National Academy of Sciences, India, Section A *(India)*

Proc. Phys. Soc. (London)
Proceedings of the Physical Society (London) changed to Journal of Physics, A, B, and C *(England)*

Proc. Soc. Water Treat. Exam.
Proceedings of the Society for Water Treatment and Examination *(England)*

Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.)
*Proceedings (Trudy) of the P. N. Lebedev Physics Institute (USSR) (English Translation of Trudy Fizicheskogo Instituta imeni P. N. Lebedeva, Akademiya Nauk SSSR) *(U. S.)*

Prod. Eng.
Product Engineering *(U. S.)*

Progr. Ind. Microbiol.
Progress in Industrial Microbiology *(U. S.–England)*

Progr. Nucl. Tech. Instrum.
Progress in Nuclear Techniques and Instrumentation *(Netherlands)*

Progr. Solid State Chem.
Progress in Solid State Chemistry *(England)*

Progr. Stiintei
Progresele Stiintei *(Romania)*

Prot. Civ. Secur. Ind.
Protection Civile et Securite Industrielle *(France)*

Protein, Nucl. Acid, Enzyme
Protein, Nucleic Acid, Enzyme
see *Tanpakushitsu Kakusan Koso*

PTB Mitt.
*PTB Mitteilungen. Amts- und Mitteilungsblatt der Physikalisch-Technischen Bundesanstalt *(West Germany)*

Pubb. Centro Sper. Agr. Forest.
Pubblicazioni del Centro di Sperimentazione Agricola e Forestale *(Italy)*

Queensland Govt. Mining J.
Queensland Government Mining Journal *(Australia)*

Radio (China)
Radio (China)
see *Wu Hsien Tien*

Radiobiol. Biol. Mol.
Radiobiologia si Biologia Moleculara *(Romania)*

Radioprotection
Radioprotection. Bulletin de la Societe Francaise de Radioprotection *(France)*

Rad. Poljopr. Fak. Univ. Sarajevu
Radovi Poljoprivrednog Fakulteta Univerziteta u Sarajevu *(Yugoslavia)*

Rakuno Kagaku No Kenkyu
Rakuno Kagaku No Kenkyu (Japanese Journal of Dairy Science) *(Japan)*

Razved. Okhr. Nedr
Razvedka i Okhrana Nedr *(U.S.S.R.)*

RCN (Reactor Cent. Ned.) Mededel.
RCN (Reactor Centrum Nederland) Mededeling *(Netherlands)*

Reactor Fuel-Process. Technol.
*Reactor and Fuel-Processing Technology (A Quarterly Technical Progress Review) (formerly Power Reactor Technology and Reactor Fuel Processing) *(U. S.)*

Rec. Trav. Bot. Neer.
Recueil des Travaux Botaniques Neerlandais *(Netherlands)*

Rend. Semin. Mat. Fis. Milano
Rendiconti del Seminario Matematico e Fisico di Milano *(Italy)*

Rep. Fac. Sci., Shizuoka Univ.
Reports of Faculty of Science, Shizuoka University *(Japan)*

Rep. Fire Res. Inst. Jap.
Report of Fire Research Inst. of Japan
see *Shobo Kenkyusho Hokoku*

Rep. Hokkaido Inst. Public Health
Report of the Hokkaido Inst. of Public Health
see *Hokkaidoritsu Eisei Kenkyushoho*

Rep. Ind. Res. Inst., Osaka Prefect.
Reports of Industrial Research Inst., Osaka Prefecture
see *Osaka Furitsu Kogyo Shoreikan Hokoku*

Rep. Nat. Res. Inst. Police Sci.
Reports of the National Research Inst. of Police Science
see *Kagaku Keisatsu Kenkyusho Hokoku*

Rep. Res. Inst. Ind. Safety
Reports of the Research Inst. of Industrial Safety
see *Sangyo Anzen Kenkyusho Hokoku*

Rep. Res. Inst. Sci. Ind., Kyushu Univ.
Reports of the Research Inst. of Science and Industry, Kyushu University
see *Kyushu Daigaku Seisan Kagaku Kenkyusho Hokoku*

Rep. Tokyo-to Lab. Med. Sci.
Report of Tokyo-to Lab. for Medical Sciences
see *Tokyo Toritsu Eisei Kenkyusho Kenkyu Hokoku*

Rep. Train. Inst. Eng. Teach., Kyoto Univ.
Report of the Training Inst. for Engineering Teachers, Kyoto University
see *Kyoto Daigaku Kogyo Kyoin Yoseijo Kenkyu Hokoku*

Res. Electrotech. Lab.
Researches of the Electrotechnical Laboratory
see *Denki Shikenjo Kenkyu Hokoku*

Res. Rep., Nagano Tech. Coll.
Research Reports, Nagano Technical College
see *Nagano Kogyo Koto Senmon Gakko Kiyo*

Rev. Acad. Cienc. Exactas, Fis.-Quim. Natur. Zaragoza
Revista de la Academia de Ciencias Exactas, Fisico-Quimicas y Naturales de Zaragoza *(Spain)*

Rev. Brasil. Quim. (Sao Paulo)
*Revista Brasileria de Quimica *(Brazil)*

Rev. Elec.
Revista Electricidade *(Portugal)*

Rev. Fr. Elec.
*Revue Francaise de l'Electricite *(France)*

Rev. Interamer. Radiol.
Revista Interamericana de Radiologia *(Peru)*

Rev. Laryngol., Otol., Rhinol., Suppl.
Revue de Laryngologie, Otologie, Rhinologie, Supplement *(France)*

Rev. Roum. Sci. Tech., Ser. Mecan. Appl.
Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee *(Romania)*

Rev. Zootch. Med. Vet.
Revista de Zootehnic si Medicina Veterinara *(Romania)*

Rheol. Acta
Rheologica Acta *(West Germany)*

Roy. Observ. Bull.
Royal Observatory Bulletins *(England)*

Roy. Soc. Health J.
Royal Society of Health Journal *(England)*

Rudarsko-Met. Zbornik, Suppl.
Rudarsko-Metalurski Zbornik, Supplement *(Yugoslovia)*
For English Translation see Mining Met. Quart., Suppl.

Ruimtevaart
Ruimtevaart *(Netherlands)*

RUM, Rev. Universelle Mines
RUM, Revue Universelle des Mines, de la Metallurgie, de la Mecanique, des Travaux Publics, des Sciences et des Arts Appliques a l'Industrie (formerly Revue Universelle des Mines, de la Metallurgie, de la Mecanique, des Travaux

Publics, des Sciences et des Arts Appliques a l'Industrie) *(Belgium)*

S. Afr. Mech. Eng.
South African Mechanical Engineer, The *(South Africa)*

Salt Res. Ind. (Bhavnagar, India)
Salt Research and Industry (Bhavnagar, India) *(India)*

Samoletostr. Tekh. Vozdush. Flota
Samoletostroenie i Tekhnika Vozdushnogo Flota *(U.S.S.R.)*

Sangyo Anzen Kenkyusho Hokoku
Sangyo Anzen Kenkyusho Hokoku (Reports of the Research Inst. of Industrial Safety) *(Japan)*

Sb. Geol. Ved, Uzita Geofyz.
Sbornik Geologickych Ved, Uzita Geofyzika *(Czechoslovakia)*

Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.
Sbornik Vedeckych Praci Lekarske Fakulty Karlovy University v Hradci Kralove, Supplementum *(Czechoslovakia)*

Scand. J. Clin. Lab. Invest., Suppl.
Scandinavian Journal of Clinical and Laboratory Investigation, Supplement *(Sweden)*

Schweiz. Arch. Tierheilk.
Schweizer Archiv fuer Tierheilkunde *(Switzerland)*

Schweiz. Muenzbl.
Schweizer Muenzblaetter *(Switzerland)*

Sciences (Paris)
Sciences et l'Enseignement des Sciences (Paris) *(France)*

Sci. Ind. Spatiales
Sciences et Industries Spatiales *(Switzerland)*

Sci. News (Wash., D. C.)
Science News (Washington, D. C.) *(U. S.)*

Sci. Proc. Roy. Dublin Soc., Ser. A
Scientific Proceedings of the Royal Dublin Society, The, Series A (supersedes The Scientific Proceedings of the Royal Dublin Society, New Series) *(Ireland)*

Sci. Rep., Coll. Gen. Educ., Osaka Univ.
Science Report, College of General Education, Osaka University *(Japan)*

Sci. Rep. Niigata Univ., Ser. B
Science Reports of Niigata University, Series B. Physics *(Japan)*

Scr. Met.
Scripta Metallurgica *(U. S.)*

Seminars Hematol.
*Seminars in Hematology *(U. S.)*

Seminars Roentgenol.
Seminars in Roentgenology *(U. S.)*

Sen'i Gakkaishi
Sen'i Gakkaishi (Journal of the Society of Fiber Science and Technology, Japan) *(Japan)*

Ser. Haematol.
Series Haematologica (Supplements Scandinavia Journal of Haematology) *(Denmark)*

Sheet Metal Ind.
Sheet Metal Industries *(England)*

Shipping World Shipbuilder
Shipping World and Shipbuilder *(England)*

Shobo Kenkyusho Hokoku
Shobo Kenkyusho Hokoku (Report of Fire Research Inst. of Japan) *(Japan)*

Showa Densen Denran Rebyu
Showa Densen Denran Rebyu (Showa Wire and Cable Review) *(Japan)*

Showa Wire Cable Rev.
Showa Wire and Cable Review
see Showa Densen Denran Rebyu

Sichere Arb.
Sichere Arbeit *(Austria)*

Slaboproudy Obz.
Slaboproudy Obzor *(Czechoslovakia)*

Soc. Petrol. Eng. J.
Society of Petroleum Engineers Journal, The *(U. S.)*

Soil Crop Sci. Soc. Fla., Proc.
Soil and Crop Science Society of Florida, Proceedings *(U. S.)*

Soobshch. Shemakhinskoi Astrofiz. Observ., Akad. Nauk Azerb. SSR
*Soobshcheniya Shemakhinskoi Astrofizicheskoi Observatorii, Akademiya Nauk Azerbaidzhanskoi SSR *(Azerbaidzhan S.S.R.)*

Sov. Antarct. Exped. Inform. Bull.
Soviet Antarctic Expedition Information Bulletin (English Translation of Informatsionnyi Byulleten Sovetskoi Antarkticheskoi Ekspeditsii) *(U. S.)*

Sov. Phys.-Semicond. (Engl. Transl.)
Soviet Physics-Semiconductors (English Translation of Fizika i Tekhnika Poluprovodnikov) *(U. S.)*

Space Biol. Med. (USSR) (Engl. Transl.)
Space Biology and Medicine (USSR) (English Translation of Kosmicheskaya Biologiya i Meditsina) *(U.S.)*

Space Life Sci.
Space Life Sciences *(Netherlands)*

Spectrum (Oxford)
Spectrum (Oxford) *(England)*

Spis. Bulg. Akad. Nauk.
Spisanie na Bulgarskata Akademiya na Naukite *(Bulgaria)*

SRW (Siemens-Reiniger-Werke) Nachr.
SRW (Siemens-Reiniger-Werke) Nachricht *(West Germany)*

Stain Technol.
Stain Technology *(U. S.)*

Steel Times
Steel Times *(England)*

Strahlenschutz Forsch. Prax.
Strahlenschutz in Forschung und Praxis *(West Germany)*

Strain
Strain *(England)*

Stud. Cercet. Endocrinol.
Studii si Cercetari de Endocrinologie *(Romania)*

Stud. Cercet. Energ. Electrotehn.
Studii si Cercetari de Energetica si Electrotehnica *(Romania)*

Svetsaren Engl.
Svetsaren in English *(Sweden)*

Sv. Lakartidn.
Svenska Lakartidningen *(Sweden)*

Sv. Naturvetensk.
Svensk Naturvetenskap *(Sweden)*

T'ai-wan I Hsueh Hui Tsa Chih
T'ai-wan I Hsueh Hui Tsa Chih (Journal of the Formosan Medical Association) *(China (Taiwan))*

Tanpakushitsu Kakusan Koso
Tanpakushitsu Kakusan Koso (Protein, Nucleic Acid, Enzyme) *(Japan)*

Tech. Dig. (Prague)
Technical Digest (Prague), Statni Nakladatelstvi Technicke Literatury *(Czechoslovakia)*

Tech. Mitt. AEG-Telefunken
*Technische Mitteilungen AEG-Telefunken (a continuation of AEG-Mitteilungen) *(West Germany)*

Technik (Berlin)
Technik (Berlin), Die *(East Germany)*

Technology (Sindri)
Technology (Sindri). Quarterly Bulletin of the Planning and Development Div., Fertilizer Corp. of India Ltd. *(India)*

Technol. Rep. Kyushu Univ.
Technology Reports of the Kyushu University
see Kyushu Daigaku Kogaku Shuho

Tech. Note Port Harbour Tech. Res. Inst., Min. Transp., Jap.
Technical Note of Port and Harbour Technical Research Inst., Ministry of Transporation, Japan
see Kowan Giken Shiryo

Tech. Petrole
Techniques du Petrole *(France)*

Tech. Rep. ISSP (Inst. Solid State Phys.), Ser. A
Technical Report of ISSP (Inst. for Solid State Physics), Series A *(Japan)*

Tech. Rep. Kumamoto Univ.
Technical Reports of the Kumamoto University
see Kumamoto Daigaku Kogakubu Kenkyu Hokoku

Tech. Rep. Nisshin Steel Co., Ltd.
Technical Report of Nisshin Steel Co., Ltd.
see Nisshin Seiko Giho

Tekhnol. Organ. Proizvod.
Tekhnologiya i Organizatsiya Proizvodstva *(Ukrainian S.S.R.)*

Tekst. Prom.
Tekstil'naya Promyshlennost *(U.S.S.R.)*

Teor. Prakt. Met., Sov. Nar. Khoz. Chelyabinsk. Ekon. Admin. Raiona, Nauch.-Issled. Inst. Met.
Teoriya i Praktika Metallurgii, Sovet Narodnogo Khozyaistva Chelyabinskogo Ekonomicheskogo Administrativnogo Raiona, Nauchno-Issledovatel'skii Institut Metallurgii *(U.S.S.R.)*

Terapia (Milan)
Terapia (Milan) *(Italy)*

Terapia (Turin)
Terapia (Turin) *(Italy)*

Thin Solid Films
Thin Solid Films *(Netherlands)*

Thoraxchir. Vask. Chir.
Thoraxchirurgie und Vaskulaere Chirurgie (formerly Thoraxchirurgie) *(West Germany)*

Tien Shih Chieh
Tien Shih Chieh (Electrical World) *(China)*

Tohoku Daigaku Senko Seiren Kenkyusho Iho
Tohoku Daigaku Senko Seiren Kenkyusho Iho (Bulletin of the Research Inst. of Mineral Dressing and Metallurgy, Tohoku University) *(Japan)*

Tokyo Astron. Bull., Ser. II

Tokyo Astronomical Bulletin, Series II *(Japan)*

Tokyo Daigaku Jishin Kenkyusho Iho
Tokyo Daigaku Jishin Kenkyusho Iho (Bulletin of the Earthquake Research Inst., University of Tokyo) *(Japan)*

Tokyo Daigaku Uchu Koku Kenkyusho Hokoku
Tokyo Daigaku Uchu Kenkyusho Hokoku (Bulletin of the Institute of Space and Aeronautical Science, University of Tokyo) *(Japan)*

Tokyo Joshi Ika Daigaku Zasshi
Tokyo Joshi Ika Daigaku Zasshi (Journal of Tokyo Women's Medical College) *(Japan)*

Tokyo Toritsu Eisei Kenkyusho Kenkyu Hokoku
Tokyo Toritsu Eisei Kenkyusho Kenkyu Hokoku (Report of Tokyo-to Lab. for Medical Sciences) *(Japan)*

Tonind.-Ztg. Keram. Rundsch.
Tonindustrie-Zeitung und Keramische Rundschau *(West Germany)*

Trans. Amer. Ophthalmol. Soc.
Transactions of the American Ophthalmological Society *(Canada)*

Trans. Indian Ceram. Soc.
Tranactions of the Indian Ceramic Society *(India)*

Trans. Ing.
*Transactions. Ingenioeren *(Denmark)*

Trans. Inst. Metal Finish.
Transactions of the Institute of Metal Finishing *(England)*

Transp. Stroit.
Transportnoe Stroitel'stvo *(U.S.S.R.)*

Trans. Soc. Instrum. Contr. Eng.
Transactions of the Society of Instrument and Control Engineers *(Japan)*

Trans. Soc. Pathol. Jap.
Transactiones Societatis Pathologicae Japonicae
see Nippon Byori Gakkai Kaishi

Travaux
Travaux *(France)*

Tr. Gos. Issled. Elektrokeram. Inst.
Trudy Gosudarstvennogo Issledovatel'skogo Elektrokeramicheskogo Instituta *(U.S.S.R.)*

Tr., Gos. Nauch.-Issled. Proekt. Inst. Splavov Obrab. Tsvet. Metal.
Trudy, Gosudarstvennyi Nauchno-Issledovatel'skii i Proektnyi Institut Splavov i Obrabotki Tsvetnykh Metallov *(U.S.S.R.)*

Tr. Inst. Biol., Akad. Nauk SSSR, Ural. Filial
Trudy Instituta Biologii, Akademiya Nauk SSSR, Ural'skii Filial *(U.S.S.R.)*

Tr. Inst. Met. Obogashch., Akad. Nauk Kaz. SSR
Trudy Instituta Metallurgii i Obogashcheniya, Akademiya Nauk Kazakhskoi SSR *(Kazakh S.S.R.)*

Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.
Trudy Kazakhskogo Nauchno-Issledovatel'skogo Instituta Onkologii i Radiologii *(Kazakh S.S.R.)*

Tr. Kom. Spektrosk., Akad. Nauk SSSR
Trudy Komissii po Spektroskopii, Akademiya Nauk SSSR *(U.S.S.R.)*

Tr. Leningrad. Tekhnol. Inst. Tsellyul.-Bum. Prom.
Trudy Leningradskogo Tekhnologicheskogo Instituta Tsellyulozno-Bumazhnoi Promyshlennosti *(U.S.S.R.)*

Tr., Mosk. Aviats. Tekhnol. Inst.
Trudy, Moskovskii Aviatsionnyi Tekhnologicheskii Institut *(U.S.S.R.)*

Tr. Mosk. Vet. Akad.
Trudy Moskovskoi Veterinarnoi Akademii *(U.S.S.R.)*

Tr. Sib. Tekhnol. Inst.
Trudy Sibirskogo Tekhnologicheskogo Instituta *(U.S.S.R.)*

Tr. Teor. Polya
Trudy po Teorii Polya *(U.S.S.R.)*

TRW Space Log
TRW Space Log *(U. S.)*

Tumor Res.
Tumor Research *(Japan)*

Tungsten News
Tungsten News *(U.S.)*

T Z Prakt. Metallbearb.
T Z fuer Praktische Metallbearbeitung *(West Germany)*

Upr. Yadern. Energ. Ustanovkami, Sb. Statei
*Upravlenie Yadernymi Energeticheskimi Ustanovkami, Moskovskii Inzhenerno-Fizicheskii Institut, Sbornik Statei *(U.S.S.R.)*

U. S. Nav. Inst., Proc.
United States Naval Institute, Proceedings *(U. S.)*

Vector (Baltimore)
Vector (Baltimore) *(U. S.)*

Ved. Pr. Vyzk. Ustavu Vet. Lek. Brne
Vedecke Prace Vyzkumneho Ustavu Veterinarniho Lekarstvi v Brne (superseded by Documenta Veterinaria) *(Czechoslovakia)*

Vestn. Cesk. Spolecnosti Zool.
Vestnik Ceskoslovenske Spolecnosti Zoologicke *(Czechoslovakia)*

Vestn. Leningrad. Univ., Ser. Biol.
Vestnik Leningradskogo Universiteta, Seriya Biologii *(U.S.S.R.)*

Vestn. Mosk. Univ., Ser. I, Mat., Mekh.
Vestnik Moskovskogo Universiteta, Seriya I, Matematika, Mekhanika *(U.S.S.R.)*

Vestn. Mosk. Univ., Ser. IV. Geol.
Vestnik Moskovskogo Universiteta, Seriya IV. Geologiya *(U.S.S.R.)*

Vestn. Ustred. Ustavu Geol.
Vestnik Ustredniho Ustavu Geologickeho *(Czechoslovakia)*

Vodosnabzh. Sanit. Tekh.
Vodosnabzhenie i Sanitarnaya Tekhnika *(U.S.S.R.)*

Vojnosanit. Pregl.
Vojnosanitetski Pregled *(Yugoslavia)*

Volt, Elec. Trade Mon.
Volt, Electrical Trade Monthly *(Japan)*

Vop. Eksp. Klin. Radiol., Khar'kov. Inst. Med. Radiol.
Voprosy Eksperimental'noi i Klinicheskoi Radiologii, Khar'kovskii Institut Meditsinskoi Radiologii *(Ukrainian S.S.R.)*

Water Res.
Water Research (supersedes in part Air and Water Pollution) *(England)*

Water Waste Treat.
Water and Waste Treatment *(England)*

Weld. Eng.
Welding Engineer *(U. S.)*

Weld. Res. Counc. Bull.
Welding Research Council Bulletin *(U. S.)*

Wiad. Hutn.
Wiadomosci Hutnicze *(Poland)*

Wien. Z. Inn. Med. Grenzgeb.
Wiener Zeitschrift fuer Innere Medizin und ihre Grenzgebiete *(Austria)*

Wiss. Z. Ernst-Moritz-Arndt-Univ. Greifswald, Math.-Naturwiss. Reihe
Wissenschaftliche Zeitschrfit der Ernst-Moritz-Arndt-Universitaet Greifswald, Mathematisch-Naturwissenschaftliche Reihe *(East Germany)*

Wiss. Z. Humboldt-Univ. Berlin, Math.-Naturwiss. Reihe
Wissenschaftliche Zeitschrift der Humboldt-Universitaet zu Berlin, Mathematisch-Naturwissenschaftliche Reihe *(East Germany)*

Wonjaryogwon. Yon'gu Nonmun Chip
Wonjaryogwon. Yon'gu Nonmun Chip
see J. Nucl. Sci. (Seoul)

World Mining
World Mining *(U. S.)*

Wu Hsien Tien
Wu Hsien Tien (Radio) *(China)*

Yadern. Priborostr., Nauch.-Tekh. Sb.
Yadernoe Priborostroenie, Nauchno-Tekhnicheskii Sbornik *(U.S.S.R.)*

Yakugaku Kenkyu
Yakugaku Kenkyu (Japanese Journal of Pharmacy and Chemistry) *(Japan)*

Yuan Tzu Neng
Yuan Tzu Neng (Atomic Energy) *(China)*

Zap. Leningrad. Gorn. Inst.
Zapiski Leningradskogo Gornogo Instituta *(U.S.S.R.)*

Zem. Beton
Zement und Beton *(Austria)*

Zemlya Vselennaya
Zemlya i Vselennaya *(U.S.S.R.)*

Zentralbl. Neurochir.
Zentralblatt fuer Neurochirurgie *(East Germany)*

Z. Ernaehrungswiss., Suppl.
Zeitschrift fuer Ernaehrungswissenschaft, Supplementa *(West Germany)*

Zh. Org. Khim.
*Zhurnal Organicheskoi Khimii *(U.S.S.R.)*

Z. Immunitaetsforsch., Allergie Klin. Immunol.
Zeitschrift fuer Immunitaetsforschung, Allergie und Klinische Immunologie *(West Germany)*

Z. Kinderheilk.
Zeitschrift fuer Kinderheilkunde *(West Germany)*

Z. Math. Phys.
Zeitschrift fuer Mathematik und Physik *(East Germany)*

Z. Mikrosk.-Anat. Forsch.
Zeitschrift fuer Mikroskopisch-Anatomische Forschung (Abt. 2 of Jahrbuch fuer Morphologie und Mikroskopische Anatomie)

(East Germany)
Zool. Zh.
Zoologicheskii Zhurnal *(U.S.S.R.)*
Z. Phys. Chem. B
Zeitschrift fuer Physikalische Chemie. Abt. B *(Germany)*
Z. Psychol. Physiol. Sinnesorg.
Zeitschrift fuer Psychologie und Physiologie der Sinnesorgane *(East Germany)*
Z. Sinnephysiol.
Zeitschrift fuer Sinnephysiologie *(East Germany)*
Z. Tech. Ueberwach.
Zeitschrift Technische Ueberwachung *(Austria)*
Z. Urol. Nephrol.
Zeitschrift fuer Urologie und Nephrologie *(East Germany)*

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